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NEW LESSONS FROM OLD PLANTINGS ..... Charles Dambach

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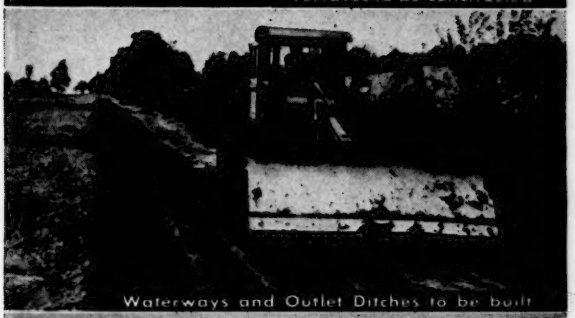
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Grass—A Tool in Soil Conservation

A. D. STOESZ and H. J. HELM

Grasses originally formed a practically continuous ground cover in the Northern Great Plains. They held soil blowing to a minimum. They controlled water erosion, so that runoff from the watersheds into the streams was clear. Soil washing and blowing were induced to some extent by heavy grazing of domestic livestock, but the problem became more acute after large tracts were plowed up. After the roots of the broken sod had decayed, the bare soil was easy prey for erosion. Many once grass-covered draws and ravines became raw gullies that marred the landscape, sloping fields became dissected, soils from the hillsides were washed onto rich bottomlands. Even areas which remained in grass became denuded and subject to erosion because of overgrazing and drought. Conservation became a problem, indeed.

Now grass has come into its own again. It is an important tool for curing the ills which had beset the Plains. As such a tool, it must be kept as a protective cover for the soil. It must be put back on those areas, no matter how large or small, that have been partially or completely uncovered. The manner in which these two jobs are accomplished usually spells the difference between success and failure. Moreover, except for unusual situations, the grass must be subjected to grazing or be mowed for hay. The problem of use is, therefore, basic in keeping or maintaining the cover. Good management, administration, and treatment are essential to improve the grasslands so that existing stands of grass may be held in place. Reseeding and subsequent treatment are the methods of restoring the cover. The work that grass is doing in the Northern Plains supports complete confidence in its effectiveness.

Maintaining a Good Grass Cover

Nothing will do as good a job of controlling wind and water erosion as a grass cover, but it must be kept in a high state of vigor and density to be completely effective. Moreover, grass acts as a soil building agent as well as a protective. It aids greatly in the development of a good soil structure and keeps the soil at a reasonable level of fertility and productiveness. Fortunately, the grasses that are relished the greatest by livestock are generally the best for controlling erosion and also offer the largest amount of feed. Thus, by maintaining a good stand of high grade forage grasses, the farmer or rancher gives the best possible protection to the land and at the same time has the best long-time returns. Properly stocking range or pasture, as determined by experience, is the most important single factor in maintenance of an adequate grass cover (Figure 1).

Good management and proper administration insure the maintenance of the grass cover except during periods of extreme drought. Poor management usually causes an intensity of grazing use far beyond the ability of the range or pasture to produce to its maximum capacity. This is a costly process for the rancher, because the plants are weakened and the best grasses are destroyed, the soil is left unprotected and is subjected to wind and water erosion. As a result, inferior grasses and weeds are encouraged to take over. This means a decreased grazing capacity and lessened weight and gain of livestock. Keeping good grass and maintaining the cover not only protects the soil; it puts money in the rancher's pocket.

Administration and management, regardless of the amount of land involved or its ownership, must be such that the land will be put to its best use. Both must adhere to the principle of soil conservation, which is "to treat every acre of land according to its needs and use it according to its capabilities." Soil losses caused by torrential rains and floods at one extreme and dust storms, such as those of the mid-1930's, at the other extreme have demonstrated the price that man must pay for plowing land that is not suited for farming. The absence of soil losses under either extreme of climate has also pointed out the rewards that come from correct use of land.

In order to correct some of the evils of land misuse, the Federal Government purchased some four and one-

THE AUTHORS of this article have brought together considerable data further giving emphasis to the importance of grass and its relationship to agriculture in all its aspects. Readers of the JOURNAL, therefore, will find it to be interesting and practical insofar as the problem, its treatment and results are concerned.

Dr. A. D. Stoesz, formerly a member of the staff at North Dakota Agricultural College, is now Senior Agronomist in the Soil Conservation Service with headquarters at Lincoln, Nebraska. H. J. Helm is also connected with the Soil Conservation Service. He is Chief of the Range Division and is located at Lincoln. Mr. Helm was formerly associated with the Forest Service where he was responsible for forest and range management work.

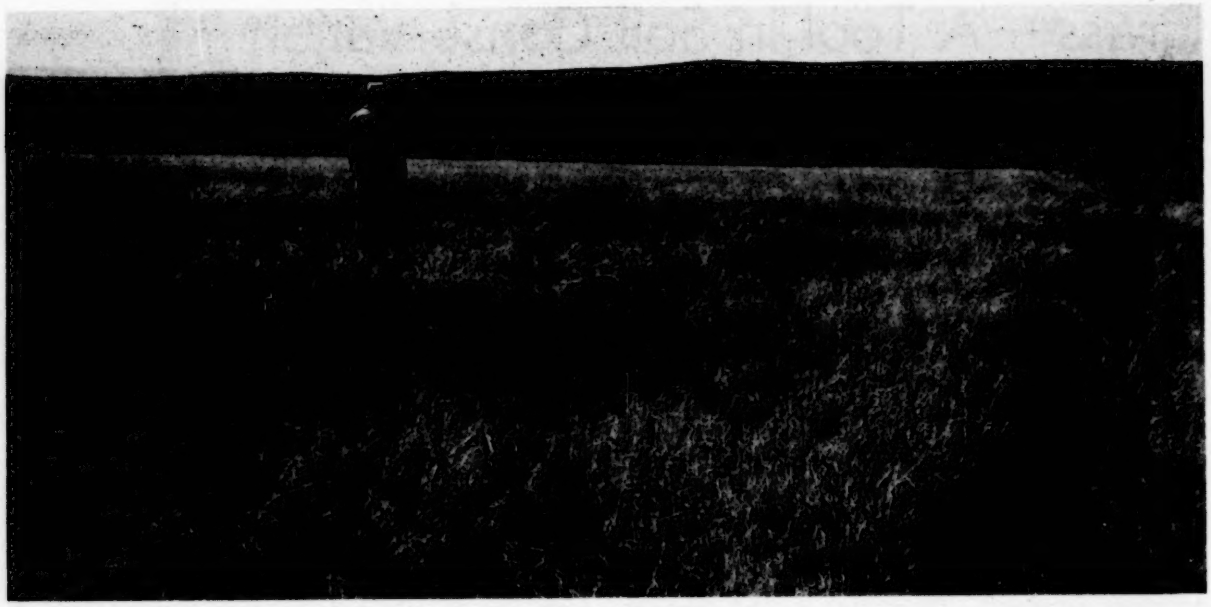

Figure 1. Native grass cover near Bismarck, North Dakota. Range conditions are excellent as a result of good management.

half million acres of land and demonstrated reseeding and proper management practices in these areas. This included abandoned or misused cropland and a little depleted grassland that was in need of protection and restoration. This land is now within Land Utilization Projects, one or more of which are located in every state of the northern plains. The total area of land within the project boundaries, which include private and all other types of ownership, is a little over 20¼ million acres. Control of virtually all grazing lands within projects has been secured by local operators, which was not formerly possible. The result is a much more stable livestock enterprise and the development of long-time plans for management of the vital resource—grass. Part of these results have been accomplished by management. Some reduction in livestock grazed, grazing in common areas, and generally good management practices have helped. And of the results part has been due to land treatment which includes 496,943 acres of reseeding, development of numerous livestock watering facilities for equitable distribution of livestock, and water spreading to increase forage growth.

Soil conservation districts afford similar opportunities for converting privately-owned land to its proper use and treating it to control erosion. Planning is done by individual pasture and range operations, but there is available an organization for district-wide adjustments if and when desired. As of June, 1948 there are 358 such districts already functioning in this area with a total of 217,405,025 acres of land involved. Besides these, there are 22 grass conservation districts in the state of Montana, with 7,033,621 acres that were set up expressly for adjusting use and administering grassland. All of the districts are working cooperatively with one or more Federal and state agencies. Also, there are a few grazing associations that are entirely private in regard to ownership, administration, and assistance, the objective being to combine separate holdings for the mutual benefit of all members. By administration and other activities, these organizations deal wholly or in part with grassland. It is to the advantage of the community as well as to the users that this be done efficiently. Although accomplishments do not always come up to complete conservation standards, the fact that grassland problems are recognized and their solution attempted by concerted action is encouraging and often effective.

Conservation Treatment of Grasslands

The recovery of grasslands that have deteriorated due to overgrazing, drought, and insect or rodent damage can be speeded by various conservation treatments. Close contour furrows and grooves reduce runoff from slopes. The moisture thus saved benefits the grasses. Pitting with an eccentric disc with pits 16 inches apart, has given best results. This treatment holds the water near the plants for use and also stimulates the growth of the medium tall grasses like western wheatgrass. The increased forage yield of pitted range at Archer, Wyoming, produced 12 pounds more mutton per acre than unpitted range and still left about 30 percent more unused forage at the end of the season for ground protection. Spreading water by means of diversion ditches

onto flats increases the growth of grasses and prevents the concentration of the runoff water in channels which eventually would form gullies. Stockwater dams and wells at proper locations and placing salt in a way to attract livestock to under-used parts of the range are of great importance. They are instruments to distribute grazing and thereby maintain a more nearly uniform cover on the land. They avoid concentration of grazing in small areas and under-use of others, such as occurred when dependence was placed primarily on natural water supplies. Some of the forage was then too far from water.

Seeding for Conservation Uses

The total grassland in the Northern Great Plains amounts to slightly more than 211,000,000 acres. In addition, approximately 9,100,000 acres are now in crops that should be restored to grass. In their eagerness to subdue the land, early pioneers plowed up large areas in the plains that should have remained in grass. Some of these lands proved unproductive for farming. Grain yields were poor and tilling the fields became difficult, especially on steep slopes and sandy lands whose shallow soils washed or blew away. Once abandoned, these fields grew up to weeds which were of little use either for grazing or for hay. The land became wasteland and failed to earn an income sufficient to pay taxes. Gullies were formed where runoff concentrated in draws which had once been protected by grass, cutting up fields so they could no longer be farmed in a solid block. It became necessary to re-establish a grass cover to repair the damage and return the land to its best use.

Until June, 1948, approximately 500,000 acres had been seeded to grass for permanent cover on Government-owned land in Land Utilization Projects, and 843,788 acres on privately-owned land in soil conservation and grazing districts—a total of 1,343,788 acres. Adding to this figure the 1,164,727 acres that have been reseeded to grass as a part of the crop rotation system of farming, brings the grand total to a little over 2½ million acres. The land thus revegetated has become more productive and supplies high quality feed for a large number of farm and ranch animals. Most of the seeded acreage in the northern part of the Region is in crested wheatgrass. This grass furnishes lush feed for livestock before most of the native grasses green up. Thus, when animals are tired of dry feed, this fresh, high protein feed enables them to put on weight before the range is ready for grazing. Then in mid-season, when crested wheatgrass becomes hard, the native range supplies excellent feed. The two together make an ideal combination in furnishing early and mid-season feed, thus saving

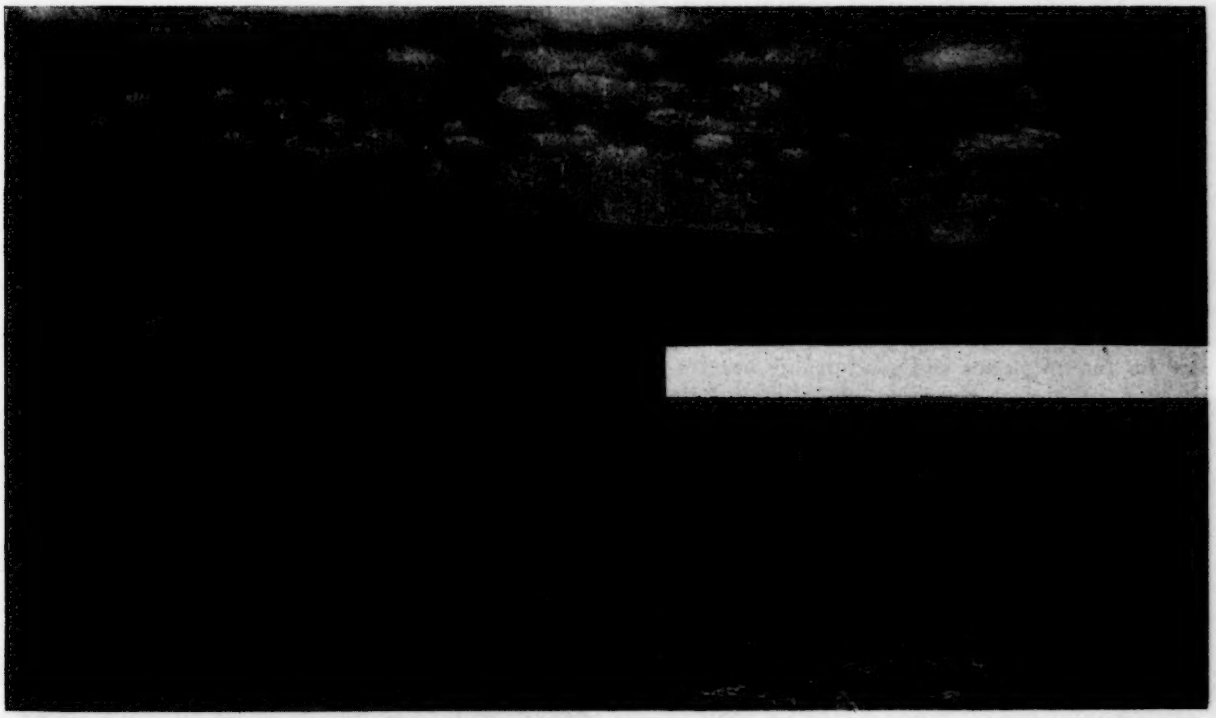

Figure 2. Abandoned farm land in Morton County, Kansas, seeded to native warm season grasses which furnish plentiful feed for cattle. The insert shows a before scene.

Figure 3. A grassed waterway consisting of bromegrass and alfalfa.

the range from abuse before it is ready for grazing. In the southern part of the Region, the native warm season grasses are used on abandoned farmlands to replace weeds with a permanent cover of nourishing grasses (Figure 2).

The reseeding job, however, is far from finished. Even though 2½ million acres have been seeded, there are still 9,100,000 acres in crops that should be seeded to grass. It is estimated that this will require approximately 100 million pounds of seed. When reseeded this land will have been returned to its proper use with grass protecting the soil from blowing and washing.

The proper disposal of runoff water by terraces requires the use of grassed waterways. Whether these are natural water courses or specially construced outlets, a grassed surface protects the soil from cutting. By June of 1948, a total of 54,755 acres of waterways has been seeded to grass in soil conservation districts in the Northern Great Plains. This took approximately 1,100,000 pounds of seed. To complete the job, however, an additional 9 million pounds of seed are required. These seeded waterways are not wasteland; they furnish grass seed for farmer income and good quality hay for livestock, in addition to providing adequate protection of the soil and providing a means of harmlessly disposing of surplus runoff water (Figure 3).

Rangelands which have been depleted by overgrazing or by insects also require reseediing. A thick stand of sage or similar unpalatable plants furnish little nourishing feed for livestock. By plowing in strips with a one way plow, heavy discing, railing or other mechanical means, such competitive plants are destroyed. Seeding adapted grasses into such fields replaces useless plants and establishes a cover that supplies good livestock feed and at the same time protects the soil adequately from erosion. This practice converts lands to a higher use and enables ranchers to obtain more profitable returns.

Grasses have other uses in conservation. Among these is the seeding of weed-infested cropland. Grasses suppress weed growth and when such fields are grazed judiciously the weeds are controlled at low cost. Furthermore, profitable returns in meat, mutton, and milk are realized from such areas which otherwise, at times, become a menace to adjoining weed-free cropland. Unsightly, unproductive, weed-infested spoil banks on drainage ditches and irrigation canals are seeded to grasses to keep them from eroding and sloughing. Grass seedings have stabilized hundreds of miles of cuts and fills on highways and country roads, converting them from eyesores to things of beauty. Properly shaped roadside ditches that are adequately protected by a grass cover now dispose of runoff water without undercutting culverts and small bridges or choking them with silt and mud. Grasses are also used effectively in strip cropping, especially where the rotation between strips is of several years' duration. For soil conservation, grass has no equal in a crop rotation. Land with poorer soil and moderate slopes, suitable only for occasional cultivation, should be in grass part of the time for soil improvement and protection. The soil structure breaks down under continuous cropping, its fertility decreases, and the humus diminishes so that less water is held for crops and more of it runs off carrying the soil with it. On sandy land, the top soil blows away and destroys crops. When such lands are seeded to grass, the roots bind the soil particles together and produce a granular structure that

(*Continued on page* 188)

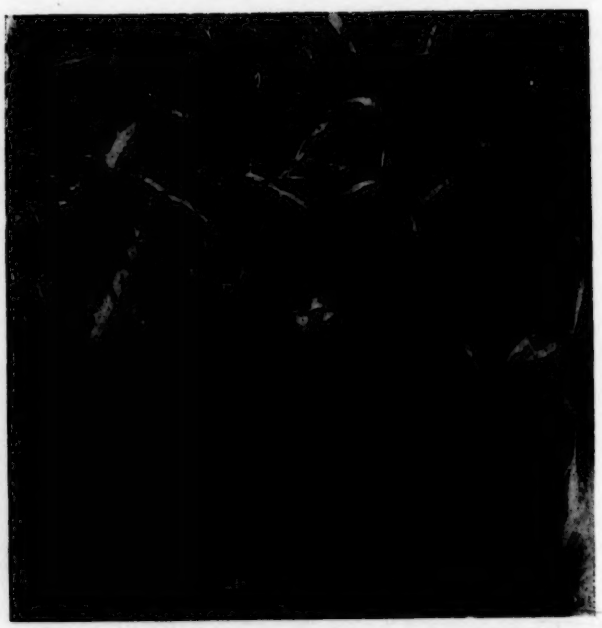

Figure 4. Good grass cover furnishes nesting area for birds.

Land Use and Soil Conservation in Japan

C. L. W. SWANSON

MR. SWANSON is Chief Soil Scientist for the Connecticut Agricultural Experiment Station with headquarters at New Haven. He was formerly Head, Soils and Fertilizers Branch, Agriculture Division, Natural Resources Section for the Allied Powers in Tokyo, Japan. Material for the article was obtained from the Ministry of Agriculture and Forestry of the Japanese Government and from Dr. W. H. Leonard, Chief of the Agriculture Division, for some recent information on the subjects covered by this paper.

JAPAN IS OFTEN REFERRED to as a country in which soil conservation and good land use is practised to its maximum. One obtains the erroneous idea that in no area of Japan does soil erosion exist. The writer is well aware of the excellent job of soil conservation accomplished on the land devoted to rice culture but there is considerable evidence that this same kind of conservation work was not applied to Japan's uplands. This article briefly discusses land use practices and soil erosion occurring in Japan, especially as they pertain to the uplands of that country. Some information is also included on the soils and crops of Japan.

Physiographic Land Pattern

Japan is a mountainous country, a solid backbone of mountains running through each of the main islands (Figure 1). About 75 to 80 percent of the area is hilly or mountainous land. Many of the mountains rise to heights of more than 8,000 feet, there being 18 important peaks of such heights, including Fuji-San with an elevation of 12,396 feet (9). The streams are short and rapid. The rugged relief is one reason why large areas of fertile soils are not found in Japan. The slopes are too steep to allow the formation of deep, relatively fertile, productive soils.

Japan lacks extensive plains or lowlands. Along great stretches of the coast, plains are absent and the hill lands reach down to tidewater. Numerous small plains occur in the mountain basins. The typical coastal plains are small, rarely extending more than 30 miles inland. The most important of these plains is the Kwanto (or Kanto) Plain comprising an area of about 3.5 million acres. Tokyo is located on this plain.

The new alluvium forms the genuine lowlands of Japan. They exist at a lower level than the "diluvial"[1] benches and terraces and geomorphologically are comprised of fans, floodplains, and deltas of new alluvium. Volcanic ash mantles much of the alluvium, as well as the "diluvial" terraces.

A typical arrangement of coastal terrain topography in Japan, from the sea to the hill land and mountainous areas, is as follows: (a) Beach ridges and dunes, (b) alluvial plains, (c) "diluvial" terraces, (d) fan of "diluvial" material, and (e) hill land and mountains with numerous intermontane basins.

Climate

The climates of Japan are a mixture of continental and marine elements, the former predominating. Factors that influence the climate of Japan include the wide variation in latitude between the northern and southern extremes of Japan, the monsoons, the ocean currents, topography, and the proximity to the mainland of Asia (3). The country is warmer than the corresponding latitudes of the Asiatic continent, but colder than Mediterranean regions on the same parallel of latitude. Summer conditions are similar to those in the northeastern and Middle Atlantic States, but the winters are colder. At all times the humdity in Japan is higher. The grow-

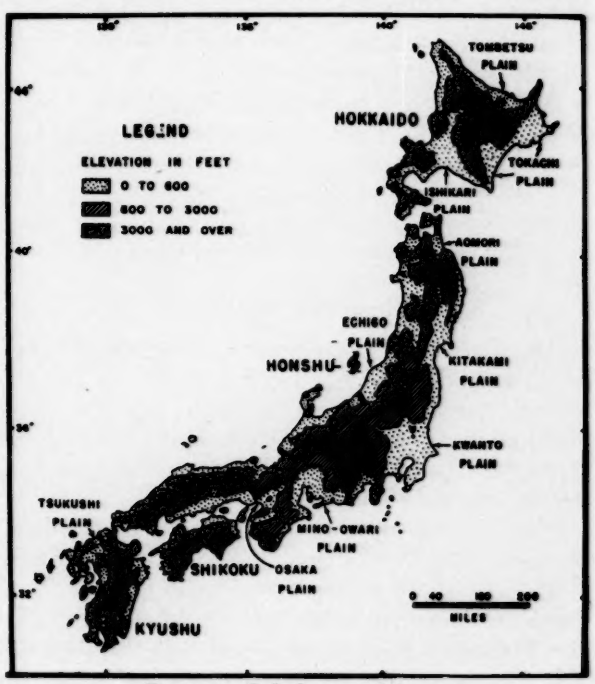

Figure 1. Relief map of Japan.

[1]The term "diluvial" has been given to these older, coarse-textured and higher terraces by Japanese geologists and geographers to distinguish them from the more recently deposited alluvium.

ing season ranges from about 120 to 130 days in central and eastern Hokkaido to 250 days or more in southern Kyushu.

No part of Japan suffers from a yearly deficiency of rainfall but occasionally droughts occur. There are no winter-dry climates. In general, precipitation increases from north to south; the precipitation for the entire country ranges from 30 to 100 inches.

Vegetation

Originally, Japan was a wooded country and even today, about 60 to 65 percent (4) of the total land area is classified as forest land. Broadleaf forests consisting of oak, beech, maple, ash, chestnut, elm, cherry, birch, and aspen types predominate, occupying about 40 percent of the total forested area; coniferous (cedar, cypress, red, black and white pine, larch, fir, spruce, hemlock) and mixed forests are about equally divided, occupying 24 and 23 percent, respectively.

Japanese forests have a dense undergrowth, reflecting heavy rainfall and high temperatures during the growing period. Dwarf bamboo (sasa) is widespread on the forest floor. In the extreme southern part of Kyushu are found numerous tropical trees and vegetation, such as palms and banana trees. Many of the river valleys in northern and eastern Hokkaido are wet, tundralike areas.

Altitude exerts an influence on the kinds of trees growing in Japan. Three general latitudinal forest zones, the warm (subtropical), the temperate, and the cold (boreal), are recognized. Each zone is bounded by approximate temperature limits (4).

About 12 percent of the land is in pasture and genya land (Figure 2). The term *genya* is translated in various ways—wild land, wasteland, prairie, meadow, pasture—but essentially it is treeless land, most of which will revert or be planted to forest. There are no areas of prairie as are found in the United States and Russia.

Soils, Crops, and Erosion

The most important and most fertile soils of Japan, which support the bulk of the population, are the alluvial soils developed in the lowlands (7). On these, paddy or irrigated rice is grown during the summer, and in southern Japan during the winter months, these soils are also cropped to wheat or barley.

Many of the important agricultural soils are developed on volcanic ash. Ando[2] soils, derived principally from volcanic ash materials and found in all areas of Japan, are important upland soils used for crop production purposes. Since these are especially low in available phosphorus, they are comparatively low in inherent fertility. They are physically well suited to growing

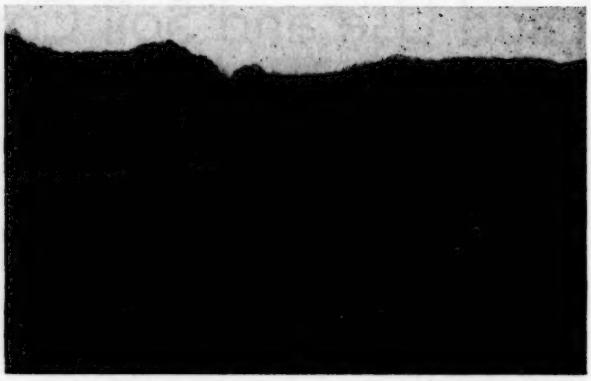

Figure 2. Grazing land near the city of Oita, Kyushu.

small grains, white and sweet potatoes, vegetables, mulberry, upland rice, tree fruits, tea, tobacco, and other nonirrigated crops.

In many of the Red and Yellow Podzolic soil areas (southern one-third of Japan), because the demand for cropland is so great, a large number of the steep slopes poorly suited to agriculture are terraced and cropped (Figure 3). The crops grown are wheat, barley, rice, white and sweet potatoes, vegetables, and, in many places on southern slopes facing the sea, citrus fruits are grown.

Most of the Gray-Brown Podzolic soils, which are developed in the hill and mountain areas of northern Honshu and Hokkaido, are forested. Where these soils are deep enough, farmers have either terraced them or planted the row crops up-and-down hill without the benefit of terraces (Figure 4). *In the unterraced fields, soil erosion is quite severe.* White potatoes, tree fruits, vegetables, small grains (wheat, barley, oats), corn, and hay are the upland crops grown on these soils. No typical Podzols are found in Hokkaido although Podzols might be expected because of the latitude and prevalent forest vegetation in this part of Japan.

Lithosols, which occur in the strongly hilly areas and in mountainous regions, are not well suited to crop production and are mostly in forest vegetation.

Erosion is also active on many of the nonarable hilly and mountainous areas of southern Honshu, Shikoku, and Kyushu. Some areas, especially in the Red and Yellow Podzolic soils areas, are *practically devoid of vegetation and are badly gullied* (Figure 5). Some of

[2]This great soil group was formerly called Brown Forest and "Black Forest" by Japanese and German soil scientists (7). The Ando soils do not have all of the profile characteristics normally associated with Brown Forest soils, being acidic in nature and slightly podzolized. In appearance the profile resembles Prairie soils except this soil (Ando) was developed under forested conditions. The term Ando is from Japanese meaning "dark soil." This name was tentatively approved for this great soil group by the 1948 Soil Survey Conference of the U. S. Department of Agriculture and State Agricultural Experiment Stations.

the land has lost considerable surface soil by sheet and rill erosion. Wind erosion is active on the Ando soils during certain seasons unless precautions are taken in the cultivations of these volcanic ash-derived soils. Clear-cutting practices on many forest lands leave large areas of land susceptible to sheet erosion. Another factor which increases the erosion hazard is the large area (7,190,000 acres) recently estimated (April, 1948) by the Japanese Bureau of Forestry in need of reforestation.

The use of land for pasture and forage crop production has received relatively little attention in Japan. Grazing now follows a pastoral pattern. Pasture (Figure 2) and harvested forage are largely what nature supplies. Little research has been done on the production capabilities of soils and crops for pasture and forage crop purposes. It is known, however, that land exists in Japan which could be properly used for pasture and forage crop production. One Japanese scientist has estimated that 4,900,000 acres of land now in grassland, mixed brush, and thin forest might be used for grazing. Although this probably is a large figure, proper renovation of suitable land to productive pasture and forage crop land not only would increase the potential food supply of Japan but would tend to decrease the erosion known to be present in many of these areas.

Cropping and Fertilizing Patterns

The farm land of Japan falls into two main groups—rice fields (irrigated land) and upland fields (non-irrigated land) which are devoted to other crops. A little more than half of the cultivated land is in paddy rice; barley (both covered and naked), wheat, white potatoes, sweet potatoes, vegetables, and fruits are the important upland crops.[3] Leonard (1, 2) has recently given detailed information on the distribution, production, and use of rice and barley. On a large part of the land two successive crops are grown each year. Two

[3]Early in 1946, the Soils and Fertilizer Branch suggested that a land use map of Japan be prepared. A map has been made by the Geographical Survey Bureau, Ministry of Home Affairs, Japanese Government, in compliance with directives by GHQ, SCAP, and technical instructions from the Soils and Fertilizer Branch, Agriculture Division of the Natural Resources Section. The land use map is published in color on three sheets with 200 meter contour intervals at a scale of 1:800,000 (published July 1947). A limited number of copies may still be available from the Agriculture Division, Natural Resources Section.

Figure 3. Terraced land near Sasebo, Nagasaki prefecture, Kyushu. A small stream has been dammed and the water used for irrigating rice.

crops of rice are rare, but much of the irrigated rice land is replanted (double cropping) to winter crops, such as wheat or barley. Multiple cropping of land is practiced widely in central and southwestern Japan. A succession of an early vegetable, a late vegetable or buckwheat, and wheat or barley is common on the upland areas. Because of this practice the area of cropped land is nearly 40 percent greater than the area of arable land.

For maximum crop yields, most of the soils of Japan require heavy fertilization and liming. Fertilizers are of real importance because of the intensive agriculture and because the scarcity of agricultural land makes it important to secure high yields from every crop grown. Because large amounts of commercial fertilizers, barnyard and green manures, composts, and night soil have been applied to crops (6, 8), the soil fertility trend on agricultural lands is upward.

Increase of Arable Land Area by Reclamation

The area of Japan is about 147,000 square miles or approximately the size of Montana. On this area live about 80,000,000 people; a density of 540 persons per square mile for the total area, or 5,330 persons per square mile of cultivated area. The preponderance of hilly and mountainous terrain sets definite limits to the cultivated area and explains why no more than 15 million acres or 16 percent of the total area of Japan is cultivated. On this land area, the farmers of Japan have provided 80 to 85 percent of the annual food requirements for their country during the past 20 years. Food deficiencies were made up by imports. With increased demand for food due principally to a rapid rise in population (69,000,000 as the 1931-1940 average), it cannot be expected that Japan will produce sufficient food now to feed her people.

There is still some land, however, that could be put into crops. The Japanese Government has prepared a plan for the reclamation of 3,900,000 acres of land for a five-year period beginning November, 1945. Nearly half (45 percent) of the area planned to be reclaimed is located in Hokkaido; here a considerable portion of the area consists of peatbeds and marsh lands. Much of the area to be reclaimed in Honshu, Shikoku, and Kyushu supports forests and low-growing brush. Apparently, many intermontane areas in Japan at elevations of 4,500 to 6,000 feet are suitable for the growing of cereal crops, white potatoes, vegetables, and pastures, but have been little used for crop production.

Only about 10 percent of the area to be reclaimed can be utilized as paddy rice land. The remainder of the area will be devoted to an upland type of agriculture. The most productive land to be put into cultivation (13 percent) is found on former military areas which occupy relatively smooth terrain.

Although plans for reclaiming an area equivalent to about 25 percent of the land now in cultivation is unquestionably highly optimistic, it is interesting that all of the land which might be cultivated is not being used for crop production purposes. An idea of the progress being made is given by the number of acres reclaimed (692,000 acres) as of April, 1948. This is about 18 percent of the total planned to be reclaimed accomplished in the first three years of the five-year plan. Nevertheless, with all the adversities with which the Japanese must contend in a war-ravaged country, it is

Figure 4. Steeply sloping land planted to crops in rows up-and-down hill in the hilly and mountainous area southwest of Sapporo, Hokkaido.

commendable that progress is being made toward putting food-producing land into cultivation.

But land reclamation for increased crop production in Japan is not new. In the two decades of 1918 to 1939 the annual amount of reclaimed land averaged about 49,000 acres, but the amount of land lost to purposes other than agriculture equalled or exceeded that average. This explains in part why before World War II no net increase in the cultivated area occurred despite the ever-present desire of the land-hungry Japanese farmers to add to their small farm holdings.

Increased Food Production Through Land Reclamation

Even though it is possible to increase the arable land area of Japan, the additional food crops harvested from this potential area is not expected to alleviate food shortages in that country altogether. Less food will be produced through reclamation of land to crops than estimated by the Japanese Government because (a) most of the really desirable land is already in use, (b) the majority of the reclaimable land left is inferior to the land now in cultivation, (c) the cost of reclamation on some land is prohibitive, (d) land has been included in the program which is not suitable for reclamation, (e) a large part of the potential cultivated land is situated (Hokkaido) where both soil and climate are particularly unfavorable and an increase of acreage by double-cropping often is not possible, and (f) conversion of uncultivated land into fields in the mountainous areas is difficult and expensive.

How much additional food can be produced will depend on the amount of land that is actually reclaimed, the inherent fertility of the soil, the availability of commercial fertilizers and farm-produced manures, speed of settlement on these new areas by farmers, and other farm management practices attendant to the operation of farm units in Japan.

The Effect of Rice Culture on Land Use and Soil Conservation

In Japan more importance has always been placed on the growing of irrigated rice than on upland crops. Practically all land areas where water can be gotton on to the land in some way, no matter what the expense or labor cost may be, is in paddy rice. Only a small amount of land exists now which can be reclaimed for paddy rice growing, while, on the other hand, quite extensive areas can be found on which upland crops may be cultivated.

In some areas, especially in the northern part of Japan, it was observed that some of the uplands adjacent to cultivated fields were in forest. There appeared to

Figure 5. Severely eroded land south of Kurume, Kyushu.

be no ecological reason for not putting these forested areas in cultivation. Reasons given in the Kwanto Plain area by the Japanese for retaining these areas in forest included (a) ownership desires to retain land in forest because it always had been in trees, (b) source for fuel and compost materials, (c) windbreaks for crops and wind erosion control, (d) maintenance of water table for cultivated land, and (e) serve as grazing areas for livestock. Investigation has shown that these reasons have basis in fact, but, tradition appears to be the main reason for these relatively flat upland areas being retained in forest. In most cases, it appears that trees growing on steep hill and mountain land could furnish the required timber products, while the level forested areas could be put under cultivation.

One usually thinks of Japan as a country that practices good soil husbandry. Probably no country takes better care of her rice lands than does Japan. Japanese farmers are among the best rice growers in the world.[4] They spare no labor in growing the crop. In many areas, in order to get more land for the growing of rice, especially in central and southern Japan, they have built elaborate terraces often of stone requiring many hours to construct (Figure 6). But these terraces apparently were not put up only for the purpose of holding the soil in place; they were built also so that the land would be made level. Water could then be directed on the land and irrigated for rice culture. It is true that dry land crops such as wheat, barley, and vegetables are grown on this terraced land but they are grown usually after the rice has been harvested. A rice and wheat or barley alternation of crops is common in Japan.

[4]According to an article by L. T. Willahan entitled, "Rice—A World Food Crop" in Foreign Agriculture, Vol. 12:115-120. 1948, Spain, Italy and Australia outoroduce Japan on average yields per acre of rough rice. Spain's highest reported average yield was 124.4 bushels per acre while the yield for Japan was 75.8. Japan, however, was the third largest world producer of rice before the war (1935-1939) in comparison to the relatively small total production of Spain.

The high priority given rice over that of other crops in Japan evidently has had its effect on upland cultural practices. *The meticulous care and arduous labor devoted to the rice paddy fields were not likewise spent on upland fields.* Since rice is the main food in Japan, attention has been focused on its production by both the Japanese farmer and the Japanese Government. *In many areas it is not difficult to find upland fields with slopes of 30 percent or more in cultivation.* Such areas were observed in Hokkaido (Figure 4), northern and southern Honshu, and southern Kyushu. Crops were being planted up-and-down the hill and soil losses were evident.

One reason why level areas are in forest (as in the Kwanto Plain) is because in many of these areas there is no source of water for irrigation readily available, nor is it practicable to bring irrigation water to them. Hills are terraced for water can be collected at the top and then applied to the terraced paddy fields at lower levels. This relative non-concern for their uplands in comparison with the emphasis placed on their irrigated rice fields probably can be attributed to the centuries old rice-farming economy well known to the average Japanese farmer.

Japanese Agriculture Versus Modern Agriculture

Popular articles often state that Japanese farmers are the best farmers in the world. This statement is only a half-truth, for agriculture in Japan is gardening rather than farming. The fields are plot-sized and most of the work is done by hand with rather primitive tools (Figure 6), usually well suited to their use. Because of unlimited labor sources, little regard is given to the amount of labor expended in growing crops. Figuratively speaking, each plant receives individual attention. Consequently, production per unit area is high but production per man is low. For example, rice yields are twice and three times as large, in some instances, as those in other major rice-producing countries. If as much individualized time and effort were given to the growing of crops in the United States, combined with current modern American agricultural practices, yields for similar crops would probably reach levels much higher than those obtained in Japan.

Figure 6. Japanese farmer preparing land for fall wheat, following the harvesting of paddy rice. Here the terraces have been constructed of large stones.

Summary

A brief description is given of the physiography, climate, vegetation, and distribution of soils and crops in Japan.

Much attention has been given to the excellent control of soil erosion in the rice fields of Japan. This paper points out that erosion is extensive in many of the upland areas in this country. Since rice is the main food in Japan, attention has been focused on its production by both the Japanese farmer and the Japanese Government. Good land use on the uplands has been relatively neglected, in comparison with land adapted to rice culture, resulting in land use practices in many areas which are conducive to decreased soil fertility and to soil erosion. There is need for the adoption of good land management practices to upland areas for erosion control practices.

Increased attention is now being given to the reclamation of large areas of land for increased food production purposes. Most of the good land is now in cultivation and only poorer land is available for reclamation purposes. Although additional food will be produced on the reclaimed land, the estimates by the Japanese on the amount of land which can be reclaimed are undoubtedly optimistic.

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New Lessons from Old Plantings

CHARLES A. DAMBACH

A SURVEY OF PLANTINGS for wildlife conservation purposes made in Ohio during the early days of the Soil Conservation Service is the theme of this paper. Charles A. Dambach, formerly with the Soil Conservation Service, is now Director of The Ohio Conservation Laboratory with headquarters at Columbus, Ohio.

MANY OF THE "MADE-WORK" creations which characterized the early efforts of the Civilian Conservation Corps, Emergency Conservation Work, Soil Erosion Service and Works Progress Administration on the nation's farms during the depression years are now nearly, and probably wisely, forgotten. In many cases the forces of nature have already obliterated such impressive structures as heavy-timbered flumes which were used to line gully channels, or the labor consuming one-man-day log and masonry dams which adorned impoverished hillsides. Although such factors as decay and uncontrolled water short-dated the usefulness of some of these early plantings efforts to control erosion they did not limit the usefulness of all of them. Among the measures which have survived this test-of-time are *some* of the experimental wildlife-erosion plantings made on farms of Civilian Conservation Corps and Soil Conservation Demonstration Area cooperators. It is the purpose of this paper to summarize the results of a survey of such plantings made under the auspices of the Soil Conservation Service in Ohio. The writer is indebted, for the opportunity to conduct this study, to the Soil Conservation Service and especially to Mr. T. C. Kennard, State Conservationist, his immediate staff and the many men in the Soil Conservation District offices throughout the state who helped in locating farms upon which plantings had been made.

The immediate purpose of the study was to appraise the success of wildlife-erosion control plantings which were made in Ohio on farms during the period from 1935 to 1940 inclusive. Planting records in old project and camp files were consulted to determine where, when and how plantings were made. These records were supplemented by field notes which had been kept by the writer while he had some responsibility for these plantings as an employee of the Soil Conservation Service. Plantings were visited during the months of August and September, 1946.

Some Historical Facts

Approximately 125 kinds of native and exotic shrubs or woody vines were used for wildlife-erosion control in Ohio during the period from April, 1934 to June, 1940 inclusive. Selection of species was based largely on known or suspected ecological adaptations. Van Dersals' Handbook of Native Woody Plants of the United States was used as a guide in selecting species after its publication in 1938.

Although reasonable care was exercised in the choice of species many obviously poor choices were made. Even the better choices often drew critical opposition from technicians and the farmers upon whose land they were to be planted. This opposition and the intense competition between agronomists, biologists, foresters and engineers for a place to work on farms in the early days of the conservation movement led to relegation of wildlife plantings to low priority consideration. This attitude was evident, in the early days of the program, in every operation which affected the success of the plantings. Shrub stock, for example, was commonly the last to be shipped from the nurseries, the last to be heeled in at the planting site and the last to be planted if it was planted at all. The myth seemed to prevail that shrubs were "brush" and brush couldn't be killed no matter how rough it was treated.

Although this treatment tried tempers and thwarted immediate progress, it forced maximum effort to meet the situation. Out of these efforts have been developed new ideas for control of erosion and the establishment of wildlife food and cover areas on farmlands in keeping with good land use, sound economics and a more abundant life—and recognition of wildlife as an integral part of the rural landscape. Although the Soil Conservation Service may justly be proud of this contribution it must be admitted that these ideas have received little attention in the speeded-up program of farm planning which is now considered so necessary to the success of the soil conservation district movement.

The Wildlife Planting Program

Five types of planting sites were treated with shrubs and vines by Service biologists in Ohio. These included:

1. *Critical areas.* These were severely eroded areas unsuited for conversion to permanent woodland because of their small size, location, low fertility or other factors. This includes such areas as steep gravel or shaly streambanks, small areas of severe pasture-gullies, steep eroding breaks between fields and roadside cuts.

2. *Field border gullies.* Small gullies where natural waterways crossed permanent field boundaries.

3. *Pond areas.* The fenced area immediately surrounding farm ponds.

4. *Odd areas.* Idle areas of land too small, or otherwise unsuited, for use as crop, pasture, or woodland. Sinkholes, natural seeps, kettle holes, and similar areas too wet for other use are included in this category.

5. *Borders.* The narrow strips of unused land between crop fields, between woodlands and cropland, between new woody plantings and cropland, contour hedges between crop fields, diversion ditch plantings, and more recently living fences.

Many of the plantings were made on the Soil Conservation Demonstration Project Areas headquartered at Cambridge, Hamilton, and Mt. Vernon, Ohio, at the time that biologists were assigned full or part-time to these areas. Additional plantings were made on the farms of Civilian Conservation Corps camp cooperators. Civilian Conservation Corps and Works Progress Administration labor was used to establish the plantings. Both nursery-grown and locally-dug native stock were used.

Results of the Program

Thirty-three established wildlife, erosion-control plantings in former soil conservation demonstration areas were studied in detail during August and September of 1946. Only plantings made prior to 1940 were visited. Most of these were planted in the springs of 1937, 1938, and 1939. Thirty-eight species of shrubs were found on 21 of these areas. Plantings on ten of the areas had already been eliminated by grazing and two of the remaining were severely grazed, although some species still persisted. A record was made of the performance of the plants still present on each area. No effort was made to account for other species presumably planted but now absent because of the many changes made between planting plans and actual planting.

Photo courtesy Soil Conservation Service

Figure 1. It has been estimated that there are more than 30,000,000 acres of idle land in small patches on farms in the United States best suited for wildlife production. Many of these areas are in need of some planting to heal erosion scars and to make them more productive of food and cover for wildlife. Group plantings as shown in this picture taken on the Sam Yanger farm in Knox county, Ohio, accomplish both objectives.

Photo by Author

Figure 2. A wildlife border around a pine planting on an eastern Ohio farm. A mixture of white cedar, hazelnut, bush lespedeza and panicled dogwood was used in this effective planting. The practical aspect of the planting is that it provides effective soil and wildlife cover in an area that would be of little productive use for crops because of shading and moisture competition from the trees.

Planting on Critical Areas. Five species of shrubs have made excellent growth and provided good erosion control cover over a period of 6 to 10 years on gullied areas and highway and stream cuts. On the heavy clay soils characteristic of western Ohio, locally dug stock of coralberry and nursery grown stock of false indigo bush have given the gest performance. Dorsett raspberry has provided excellent ground cover on less heavy and on very light soils. Hazelnut and bear oak have performed surprisingly well on light textured or sandy soils. False indigo is without question the outstanding plant in this group. It merits further trial on critical sites. Dorsett raspberry also should be given further trial.

Field Border Gullies. A number of different plants were used in this type of planting, including several kinds of dogwoods, bush lespedezas, and coralberry. The last named species has given the best results. Its low, dense habit of growth and many slender stems are admirably adapted for this purpose. Live dams of coralberry in field border washes, particularly in the Indian Creek Watershed in Butler County, have been very effective. They have changed little in appearance since their establishment nearly ten years ago and with one exception have not shown a tendency to spread. On several farms live-coralberry dams are now filling the gaps caused by collapse of "one-man-day" rock dams.

Pond Areas. Available plantings sites around ponds were usually more favorably endowed with natural fertility and were more moist than other planting areas. They were usually, for this reason, less in need of erosion-control plantings than other types of areas, since a fence alone frequently sufficed for this purpose. Judicious plantings of trees and shrubs around ponds, however, greatly improved their appearance and added to their utility as a place for family picnic outings. They are of special value to wildlife because of their proximity to a permanent source of water. Survival of most pond wildlife plantings, however, has been low for one or more reasons. The most frequent apparent cause for failure is severe competition with weeds or grasses. Suppression of herbaceous growth by making large scalps at the time of planting and a little attention later in the season to cut down tall weeds is frequently necessary on these sites. The second most important limiting factor is grazing. Several plantings were observed (Butler and Knox County area) which showed considerable promise six or eight years ago but which now are obliterated by grazing cattle and hogs.

A large variety of plants have performed well on pond

sites. Two which show the most promise are multiflora rose for moderately dry sites and silky dogwood on moist parts of the areas. The former may be used to provide some protection from livestock and perhaps undesirable tramping by people. The rose produces dense year-around cover and winter food and the dogwood produces an abundance of midsummer and fall fruit. The same is true of mulberry which grows rapidly on pond sites but soon becomes too large to provide effective ground cover.

Odd Areas. Many different species of plants were used on the various odd-area plantings on cooperators' farms in the state. Performance of these species with a few exceptions were not consistent. On a few areas some species like the bush honeysuckle have made phenomenal growth while on other areas the same species have not fulfilled expectations. The species giving the most consistently good performance on such areas are: False indigo and Dorsett raspberry on light to heavy soils and hazelnut on the very light soils. Bush lespedezas have done well when tried but have not been used on a large enough scale to judge their value in this state. Considerable losses occurred in many of these plantings because of unimpeded weed growth.

Borders. Border plantings, particularly shrub borders between new tree plantings and crop land, have proved to be very effective. Many plantings of this type were made in the Cambridge Project Area durng the period 1937 to 1940, inclusive. They now are attractive fringes on locust and pine plantings which serve the multiple role of erosion control, protection of the woodland planting from drying winds, protection of the cropland from encroachment by the woodland and serving as excellent food and cover for wildlife.

The most successful border plantings observed were mixtures of one or more of the shrub dogwoods (gray stem, rough-leafed, or silky) with an occasional hazelnut and wild plum. Even white cedar when used as a border on severely eroded Muskingum soil performed well.

Taking into account erosion control, windbreak, and wildlife values, and other factors such as home use of fruits and appearance, the most favorable species for borders appear to be: on upland sites—gray stem and rough-leafed dogwood, hazelnut (on light textured soils) and multiflora rose. On better sites with deeper and more moist soils silky dogwood should be included in this group.

Multiflora rose has been advocated for use as a living fence, particularly around pasture gullies. None of the Ohio plantings of this plant were old enough to judge their merits for this purpose.

General Conclusions

Only a small number of the many plants used in this program have proved satisfactory under most of the conditions imposed upon them. A remarkable range of adaptation to site was apparent, however, when planting stock was given proper attention, as was the case with most of the plantings in the Cambridge area. In general, there were three major factors limiting success of the planting: (1) adaptation to the site (principally physical soil condition); (2) proper handling of stock, including elimination of undue competition; and, (3) protection from fire and grazing. All three are necessary for success.

The relative performance of the plants observed is presented in the list below with notes on site adaptation.

(A) *Species capable of providing good erosion control cover on difficult sites and recommended for continued use.*

(1) False indigo (*Amorpha fruticosa*)—Suitable for use on heavy and dry soils. May be suitable for light textuerd areas also.

(2) Coralberry (*Symphoricarpos vulgaris*)—Suitable for use on heavy soils. It should not be used in areas where there is danger of its spreading.

(3) Dorsett raspberry (*Rubus thyrsanthus*)—A dense low-growing plant which produces a fair crop of fruit prized for pies, jams, and jellies. Grows well on light and medium-textured soils.

(4) Hazelnut (*Corylus americana*)—Provided good erosion control cover only on light-textured soils. Hybrid forms provided cover equal to native species and produced fruit superior in size and quantity to the native species.

(5) Bush lespedeza (*Lespedeza bicolor and L. cyrtobotrya*)—Too little is known of the growth of these plants under Ohio conditions. Their favorable progress on four sites was observed. They are a promising species for use on difficult sites and for border plantings and warrants further trial for these purposes.

Bear oak (*Quercus ilicifolia*) is omitted from this group because of the limited trial it has been given. Further observational work with this plant is desirable particularly on sandy areas. Its high production of acorns makes it a potentially fine wildlife food plant for some areas.

(B) *Species with a wide range of site tolerance and suitable growth form for erosion control purposes and wildlife food and cover values.* Recommended for border, odd area and pond plantings.

(1) Multiflora rose (*Rosa multiflora*). An excellent border plant. Advocated for use as living fences. Excellent food and cover for farm wildlife.

(*Continued on page* 190)

Land Features Influencing Use in the Middle Allegheny Plateau

F. G. LOUGHRY

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DETAILED SOIL CONSERVATION SURVEYS made as a basis for conservation farm planning have an extra value in the general information they provide. Their first use is to give soil, slope, erosion, and land use data for individual fields and farms. When a large area has been surveyed these data may be brought together and general conclusions drawn.

In the course of the conservation surveys of demonstration areas and soil conservation districts millions of acres have been mapped. For complete surveys, tables are available showing the interrelations of the four factors of soil, slope, erosion, and land use.

The first example of bringing this kind of data together for a physiographic region was in a paper by H. R. Adams. In 1946 he told the Soil Science Society (1) about the influence of certain soil features on land use in the Glaciated Plateau of Southern New York.

Area Fairly Uniform

In order to apply similar analysis to a different area where other factors are important the Middle Allegheny Plateau section was selected. This is a fairly uniform area comprising about 14 counties in Western Pennsylvania, West Virginia, Maryland, and Ohio. It lies between the glacial boundary and the Allegheny Front. The forested section of north central Pennsylvania, and the mixed limestone and shale area southwest of Pittsburgh are excluded. Within the region considered, five areas have been surveyed with a total coverage of 771,060 acres. Geologically, the area is made up of interbedded sandstones and shales of the Allegheny and Conemaugh formations. There are also productive coal strata and a few thin beds of limestone. Some of the shales are clay shales but generally the siltstones predominate. The entire region has been thoroughly dissected by tributaries of the Allegheny, Monongahela, and Ohio Rivers. Hills range from 200 to 600 feet above the stream valleys. The soils are mostly residual from the local rocks and bear a close relation to the underlying strata.

The soil classification for the area is well established and fairly simple. For the duration of the surveys analyzed here, the slope and erosion classifications were standardized and data are easily consolidated. The soil classification in use is based on:

1. Origin or physiographic position
2. Parent material
3. Depth and internal structure
4. Natural drainage

Stoniness Important Factor

The additional feature of soil texture is used in the classification but has proved of minor significance because nearly the entire area has medium textured surface soils. The few exceptions are quite striking but are always closely related to the parent material. Stoniness, a soil feature sometimes included with texture, is a very important factor in land use.

Based on the significant ranges of these factors the soils mapped could be consolidated in 26 groups for further analysis. Groups contain from one to five series and usually two or three closely related textures. For study of single factors these groups can be further combined and general comparisons drawn.

Thus it appears that of the entire area surveyed 80.2 percent is residual upland, 13.1 percent is colluvial, 3.0 percent is alluvial terraces above flooding and 3.7 percent is alluvial floodplains. The material of the residual soils is predominately sandstone, shale, and siltstone as shown by the following:

Acid sandstones and shales	98.3 percent
Interbedded sandstone, shale and limestone	0.5 percent
Calcareous red clay shale mixed with acid shale	1.2 percent

With this distribution of residual soils the colluvial and alluvial soils are virtually all derived from acid sandstone and shale materials.

How Residual Soils Class

Of the residual soils 8.1 percent class as deep with friable subsoil and substratum, 65.2 percent as shallow to moderately deep with friable subsoil. The remaining 26.7 percent is of variable depth but has heavy, compact, slowly permeable subsoil and substrata that limit effective depth. Natural drainage as indicated by visible

soil features such as color and mottling can be summarized as follows:

Good	63.3 percent
Imperfect	31.8 percent
Poor and very poor	4.9 percent

Of the entire area 16.6 percent is classed as stony.

In an area where general farming has been practiced for at least 150 years without sudden changes we may assume a direct relation between land use and the land features of recognized importance. The best adapted soil areas tend to be used for cropland, while the least adaptable generally remain in woods. Intermediate areas are cleared for cultivation, then are converted to pasture, or allowed to remain idle, and eventually revert to woods. In the Middle Allegheny Plateau these processes are modified by the mineral wealth of coal, oil, gas, etc. Land is held for non-agricultural purposes even though it may be suitable for cropland. This is shown by a fairly high proportion of idle land and woodland on even the best agricultural soils. The data reported here include all of the land within the survey areas, not merely the land in farms.

Slope Factor Eliminated

In table I there is a comparison of land use on deep, well drained, nonstony soils developed from acid sandstone and shale materials in different positions. The comparisons are limited with slope of less than 12 percent to eliminate slope as a controlling factor.

TABLE I - Origin or Physiographic Position and Land Use

Origin	Cropland Percent	Idle Percent	Pasture Percent	Woodland Percent	Farmstead and Urban Percent	TOTAL
Residual upland	50.7	14.2	7.0	26.8	1.3	100.0
Colluvial	56.0	15.6	15.0	11.9	1.5	100.0
Terrace (No flooding)	53.0	15.4	6.7	13.7	11.2	100.0
Floodplain	26.6	20.4	8.9	33.9	10.2	100.0

The relatively high use of colluvial soils for cropland reflects their location on lower slopes and adjacent to roads and farm buildings as well as their superior water-holding capacities. Likewise their use for pasture reflects both their location near flowing streams which provide stock water and their ability to produce grass throughout the summer. Terraces which are nearly flat areas close to large streams but above overflow are ideal townsites and this accounts for the very large proportion in farmstead and urban uses. Flooding hazard greatly reduces cropland use of the floodplains and increases the proportion of idle land. Urban use has disregarded flood hazard to a serious degree and encroached on the well drained floodplain. High urban and industrial flood losses in the area indicate that this adjustment to environment is not as good as that of agriculture.

Depth Influence Slight

Other data not presented in detail indicate that when comparisons are limited to similar slopes, and to well-drained soils derived from the same material, shallow soils are used the same as deeper soils. No very shallow areas were available for comparison and the group described as shallow had an average depth of about 20 inches as compared with 36 inches for the deeper group.

A group of well-drained soils with rather intractable subsoils derived from clay shales is being used for cropland in slightly higher proportion than the mixed sandstone and shale soils. Soils with some limestone mixed with the sandstone and shale are recognized as superior as shown by a high proportion in cultivation and very little idle land. In the areas studied this kind of land is not extensive and usually occurs in small strips which are not convenient for pasture. In areas not included in this survey pasture has been observed as very extensive on this soil group.

Two soil groups which have heavy intractable surface soils coupled with good drainage and fairly high natural fertility are less than half-used for cropland and have high proportions of idle land and pasture.

Stoniness and the degree of land use are closely related. For moderate slopes all non-stony soil groups in the area average 45.0 per cent cropland and 25.7 percent woodland. For the same slope range all stony soil groups average only 1.1 percent cropland and 94.0 percent woodland.

Effect of Drainage

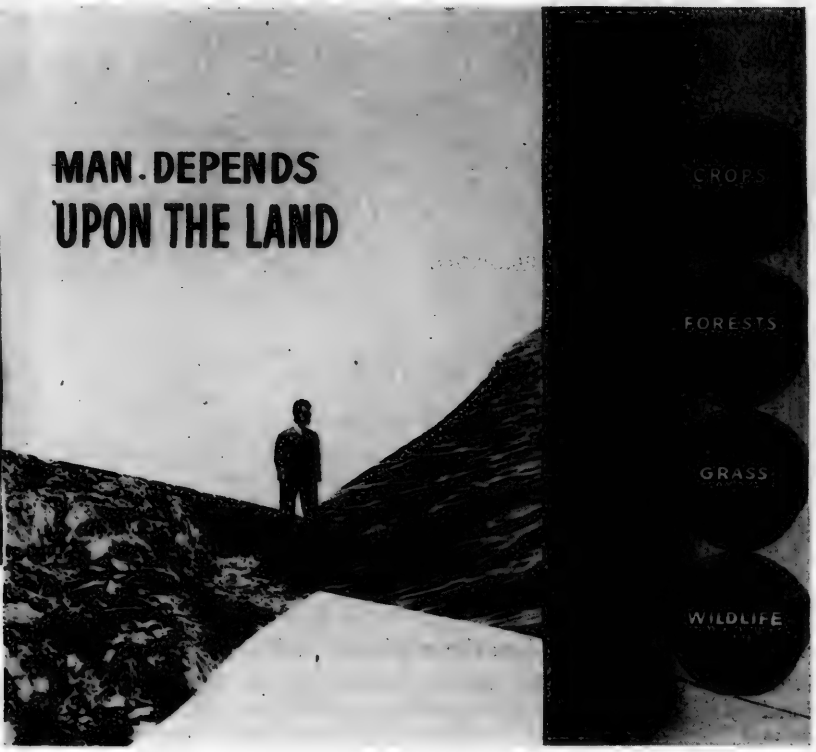
Natural drainage is an important factor in crop adaptation, productivity, and the ease of cultivation. It might quite properly be expected to be closely related to the land use figures. Table II shows this relation for non-stony upland soil groups. Similar comparisons for the colluvial, terrace, or floodplain soil groups show the same relationship.

TABLE II - Effect of Natural Drainage on Land Use of Non-Stony Upland Soils on Moderate Slopes.

Natural Drainage	Cropland Percent	Idle Percent	Pasture Percent	Woodland Percent	Farmstead and Urban Percent	TOTAL Percent
Good	51.6	16.4	7.3	22.6	2.1	100.0
Imperfect	46.1	17.6	6.9	27.7	1.7	100.0
Poor and very poor	25.7	20.2	13.1	40.5	0.5	100.0

A small portion of the imperfectly and poorly-drained cropland has some degree of artificial drainage. Idle land and pasture increase sharply when poorly drained soils are compared with those with better drainage. In

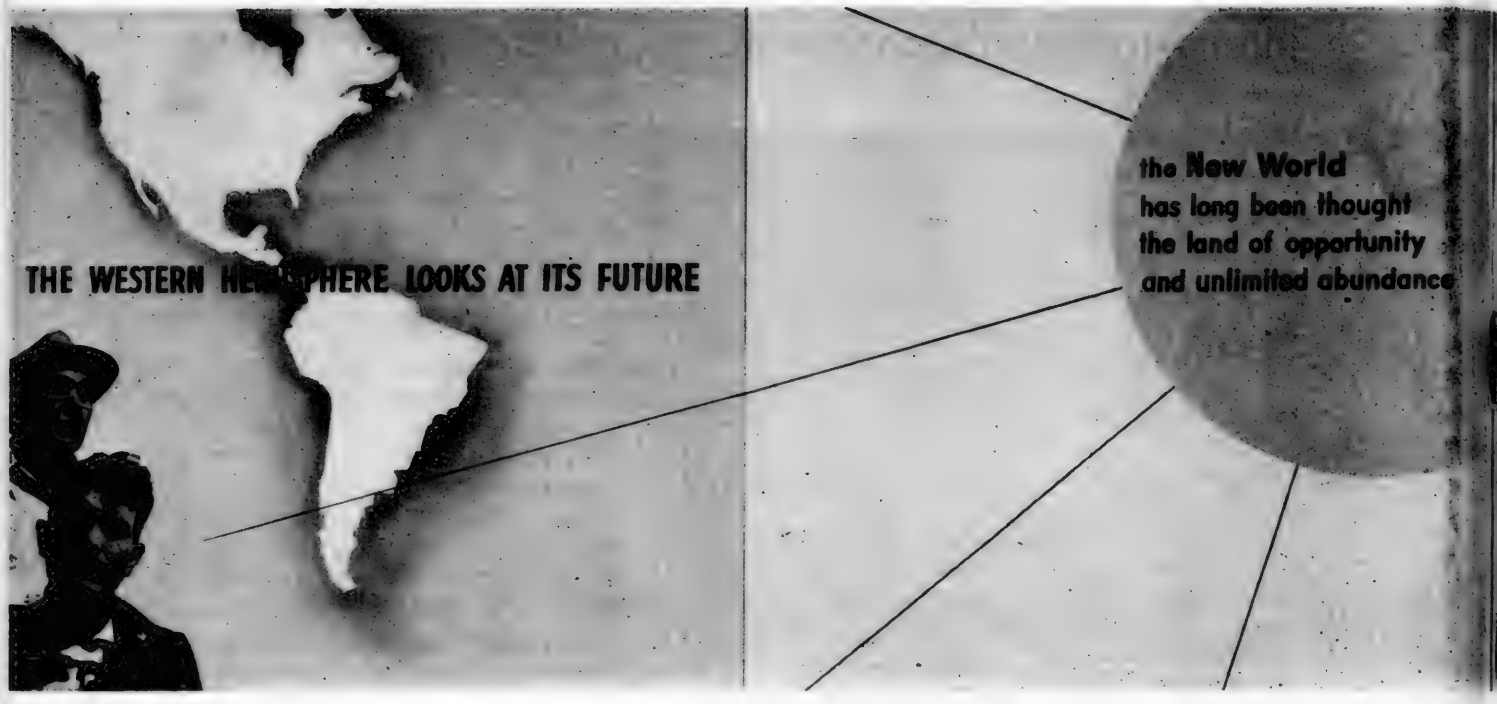
Inter-American Conservation Conference in Pictures



The Pictorial Section presents a small group of pictures showing the kind of exhibits that were on display at the Inter-American Conference on Conservation of Renewable Natural Resources held at Denver, Colorado, September 7-20, 1948.

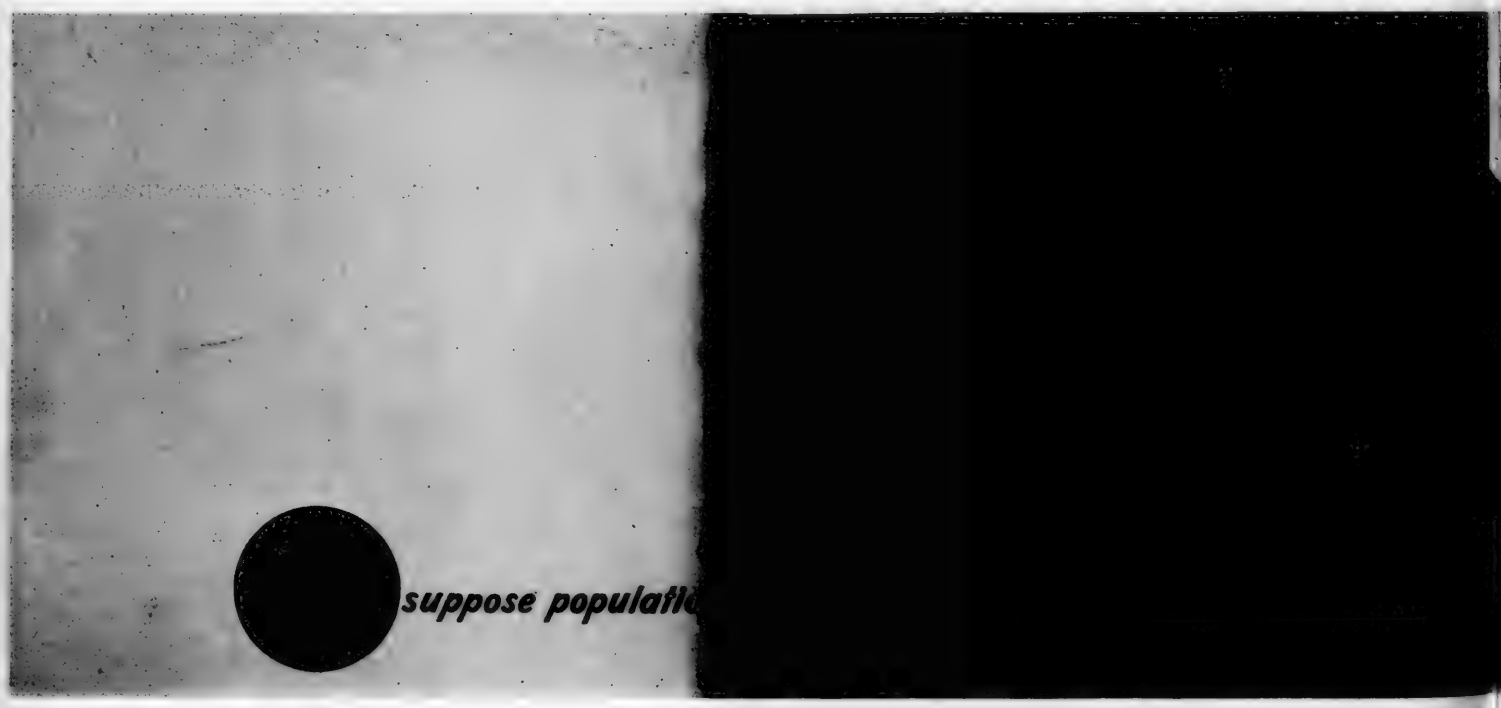
Each exhibit represents a central theme that was discussed during the conference by the delegates that were in attendance. The entire group of exhibits, following the same principle, served as a means to visually portray the purpose and objectives of the conference. Those in attendance reported that the exhibits were most helpful in keeping the central theme of the scheduled programs and discussions well coordinated.

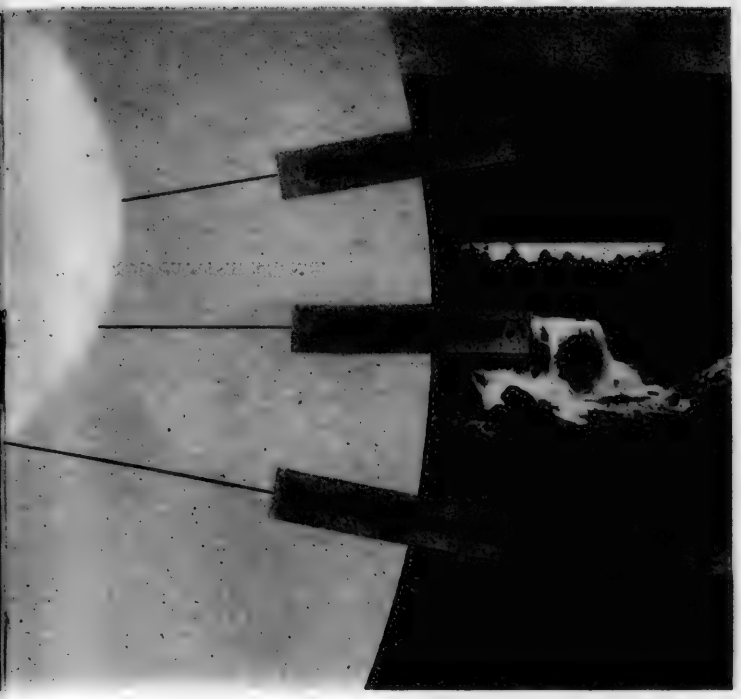
The principal theme in each exhibit was presented in Spanish and English—both appearing on the same panel. It was impossible, however, to reproduce the Spanish version because of mechanical reasons.


THE WESTERN HE PHERE LOOKS AT ITS FUTURE
the New World
has long been thought
the land of opportunity
and unlimited abundance

Fairfield Osborn, among many other speakers, emphasized the need for the preservation and wise use of our resources. He said: "This conference represents the joining in mind and spirit of the republics of the New World in an attempt to resolve the most basic problem that faces the world. No country has yet been able to adopt a "modus Operandi" by which living natural resources are being properly used for the long term health and safety of its people.

The New World is new no longer, and we are forced now to recognize that the preservation and wise use of our life-



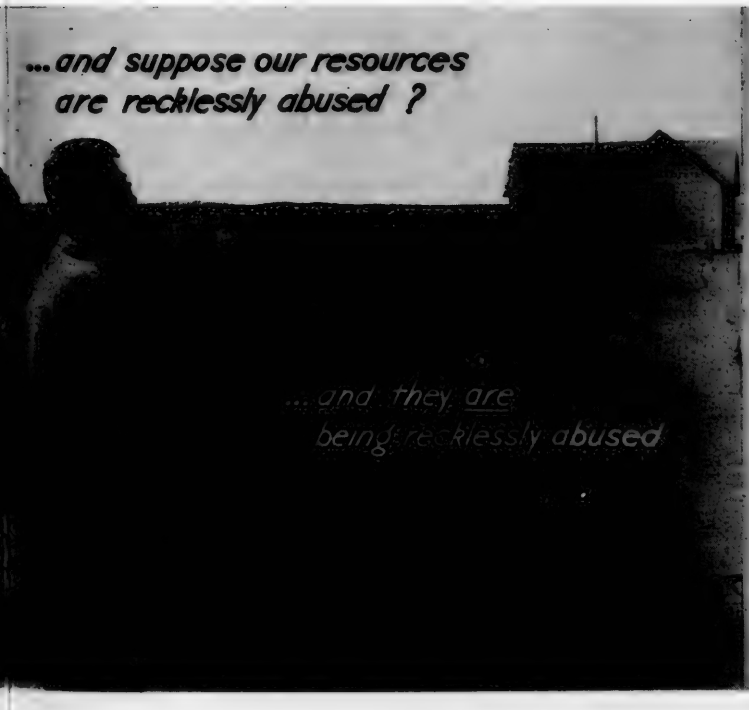


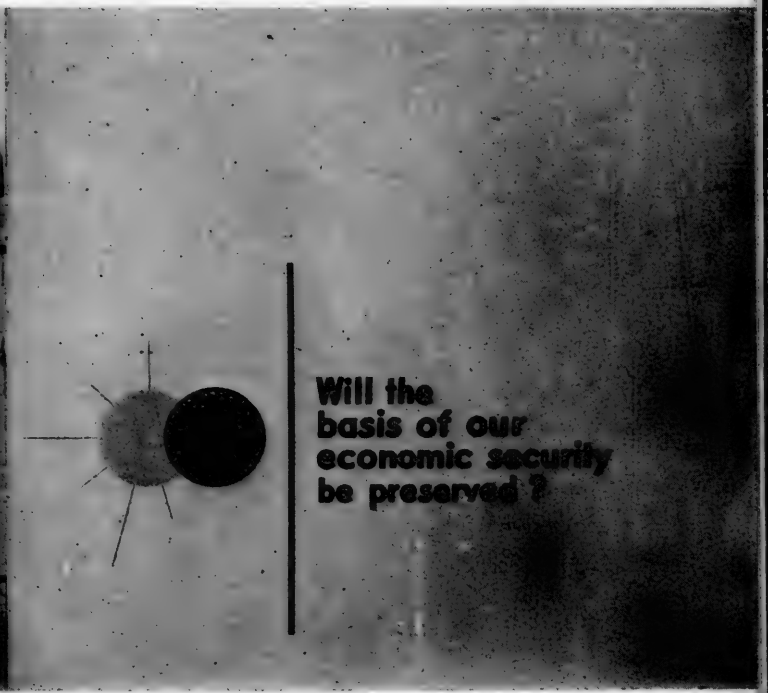
supporting resources must be handled in recognition of growing numbers of people. Such resources must be considered in unity rather than in entirely separate categories. Soils, timber, and water are closely interdependent and must be managed in a single program."

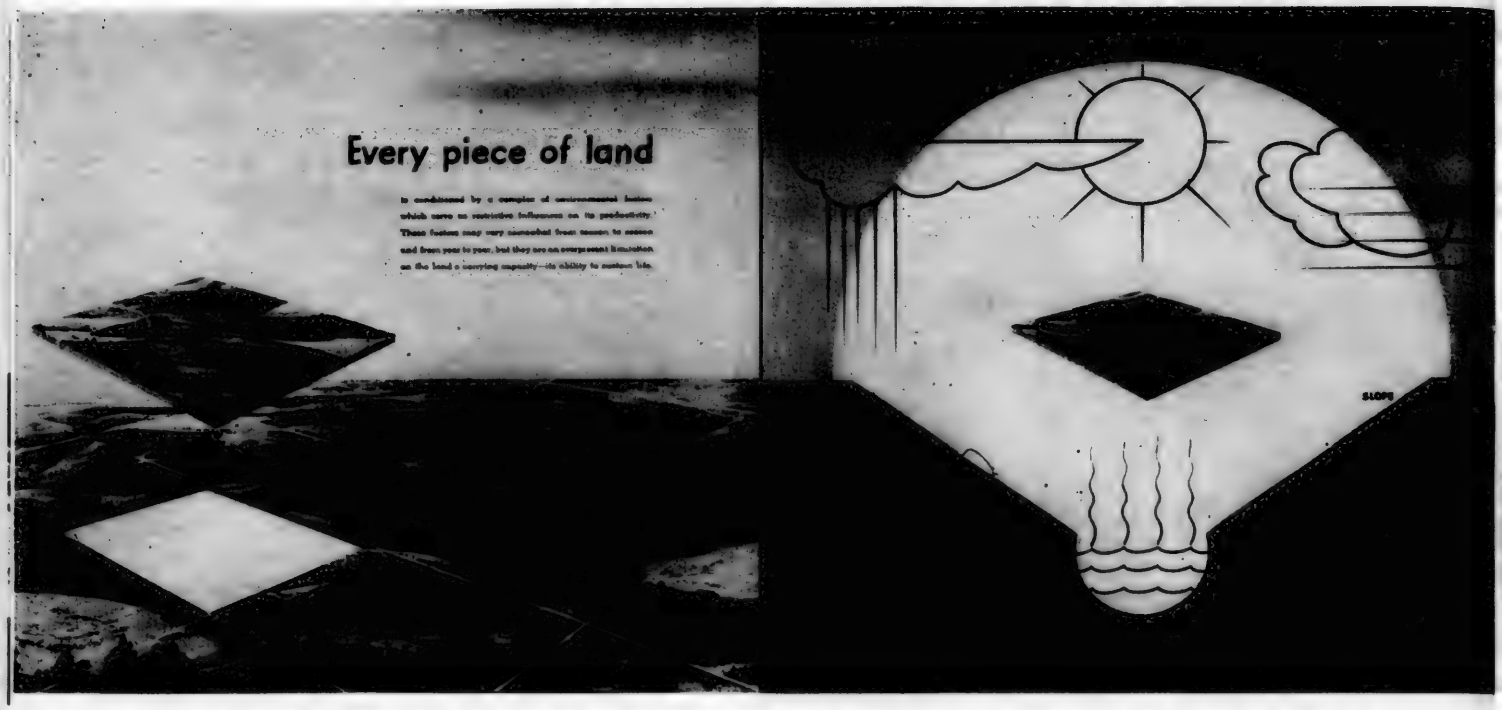
Conservation Education

"The problem implicit in our purpose is composed of many complex problems intricately bound together. It is so tremendous that it can be solved only by bringing to bear on it all the instruments of scientific and social knowledge and all the skills of politics. The many specialties of the physical and biological sciences must be focused on it, together with the many techniques of engineering. But these are not enough. Conservation requires the co-ordinated assistance of all branches of knowledge that deal with peoples and their institutions. Economics, ecology, sociology, psychology, anthropology —all these and many other disciplines must guide us in the application of what the basic sciences have shown to be desirable. It is no longer possible to approach this problem from a simplistic standpoint. The approach must be many-sided, utilizing our entire heritage of knowledge in a co-ordinated effort. Implicit in our purpose is the constant augmentation of knowledge. Conservation requires continuous advance in our understanding of nature."

—From Declaration of Purposes
Plenary Session, September 17, 1948

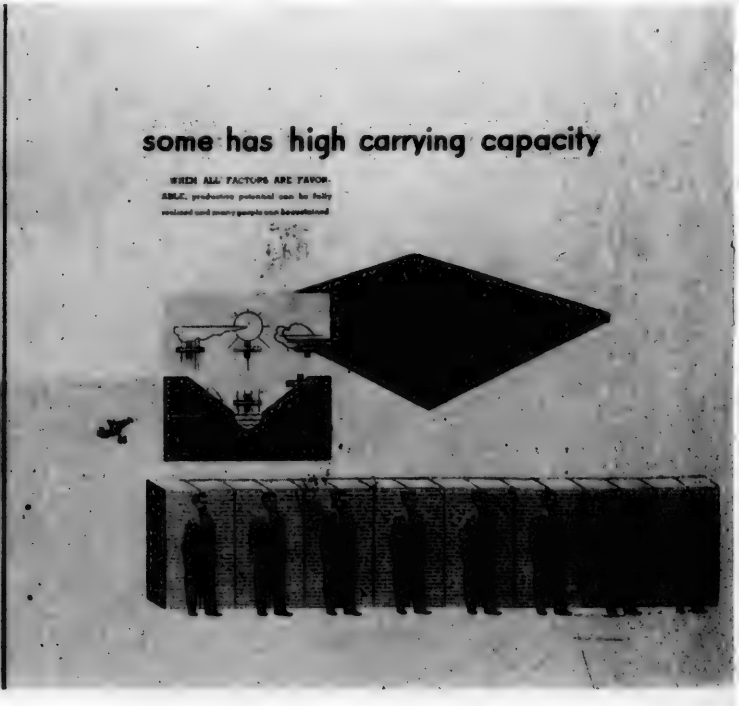






"We must plan in terms of at least the next hundred years and of pressure on world resources generated by greatly increased populations. And we must be guided not by customary private financial criteria and conventional economics, but by the larger considerations of future human welfare and security. The conservation of a nation's resources in the interest of generations yet unborn demands a new form of economics based upon human security and welfare. . . . Agreeing that all natural land covers are complex biological units in which soil, water, animal and plant life, and climate all interact so that disturbance in one affects all others, we are forced to recognize the essential unit of timber, range and water conservation problems. And we are strongly persuaded, I believe, toward adoption of the general philosophy of the ecological approach in meeting the conservation challenges of our times."

—E. I. Kotok, *Washington, D. C.*



this area both mark the abandonment of cropland and much of the pasture is of low quality. The high figure for pasture does not indicate desirability of pasture but rather the undesirability as cropland.

The effect of flooding hazard on land use practices is well illustrated by comparing the floodplain soils with older alluvial terrace soils where there is no danger of flooding. The soils compared are similar in origin and depth, and groups can be paired according to drainage. When this is done the non-flooded terrace soils show at least twice as much cropland as the floodplain. The floodplain shows more pasture and much more woodland.

Slope May Determine Use

In a hilly section such as this, slope is often the determining factor in land use through its effect on tillage, erosion, and water retention. Table III shows the relationship of slope and land use for the well-drained non-stony sandstone and shale soils which make up almost half the area surveyed.

TABLE III—Distribution of Land Use for Each Slope Class for Well Drained Acid Upland Soils.

LAND USE	SLOPE CLASS AND RANGE					
	A	B	C	D	E	
	0-5%	5-12%	12-25%	25-35%	35%	All Slopes (%)
Cropland	56.9	49.5	41.1	25.2	10.0	38 7
Idle	15.7	16.5	20.1	23.3	21.3	19.5
Pasture	5.9	7.4	11.1	14.1	13.5	10.5
Woodland	19.9	24.4	26.4	36.9	54.9	30.0
Farmsteads and urban	1.6	2.2	1.3	0.5	0.3	1.3
Total	100.0	100.0	100.0	100 0	100 0	100 0
	Acres	Acres	Acres	Acres	Acres	Acres
Total area	26,486	89.259	146,785	57,316	36,111	355,957

These data show a decline in cropland and increase in pasture and woodland as slopes get steeper. The original acreage data shows that for a total cropland acreage of 137,707 only 3,626 acres are on slopes steeper than 35 percent.

For a similar group of imperfectly drained soils the advantages of cropping flat land are nearly balanced by the difficulties of providing drainage. There is no significant variation of use with slope until comparatively steep slopes (over 25 percent) are reached.

With poorly-drained soils the difficulty of drainage overbalances the slope factor and the relationship is the reverse of that for well-drained soils. Table IV shows this for a group of poorly drained non-stony upland soils.

Erosion by running water is commonly associated with slope. The data available from these surveys show how erosion has affected the normal soil profile. Table V for cropland on shallow, well-drained upland soils compares slight, moderate, and severe erosion on each slope class.

TABLE IV—Distribution of Land Use for Each Slope Class for Poorly-Drained Non-Stony Acid Upland Soils.

LAND USE	SLOPE CLASS AND RANGE					
	A	B	C	D	E	
	0-2%	2-8%	8-15%	15-25%	25%	All Slopes (%)
Cropland	18 4	31.3	34.1	47.7		25.6
Idle	19.0	20.7	27.9	11.4		20.1
Pasture	13.8	12.7	12.0	22.7		13.2
Woodland	48.6	34.6	26.0	18.2	100.0	40.6
Farmstead and urban	0.2	0.7				0.5
Total	100.0	100.0	100.0	100.0	100.0	100.0
	Acres	Acres	Acres	Acres	Acres	Acres
Total area	7.701	9,090	434	44	12	17,281

TABLE V—Relation of Erosion to Slope of Cropland on Shallow, Well-Drained Upland Soils.

Degree of Erosion	SLOPE CLASS AND RANGE[1]				
	A	B	C	D	E
	0-5%	5-12%	12-25%	25-35%	35%
Slight	45.9	7.0	1.4	1.3	2.0
Moderate	53.6	90.5	87.5	53.6	28.9
Severe	0 5	2.5	11.1	45.1	69.1
Total	100.0	100.0	100.0	100.0	100.0

[1]Mapping classes grouped to the following:
Slight—Less than 25 percent of surface soil lost.
Moderate—From 25 to 75 percent of surface soil lost or some gullies.
Severe—Over 75 percent of surface or numerous deep gullies.

These data show the expected relationship with severe erosion increasing from almost nothing on the lowest slopes to over two-thirds of the area of the steepest slopes.

Idle Land More Eroded

Further examination of the relation of erosion to soil groups and to land use is possible with these data. In general they show that idle land is somewhat more severely eroded than cropland, indicating that some land has been dropped from cultivation because of erosion conditions. Pasture on slight to moderate slopes has about the same severity of erosion as cropland. On the steeper slopes there is less severe erosion in pastures than on corresponding slopes in cropland. Erosion in woodland is nearly all slight except for areas which have been cleared at one time and suffered soil loss under some other land use. Such areas make up a very small percentage of the total woodland.

Severity of erosion on several of the soil groups has been analyzed for comparable slopes and land use. Table VI shows the proportion of severe erosion on cropland for four soil groups. Figures for idle land and pasture are similar except the soil group containing red clay shales is comparatively more eroded in idle land than in the other uses.

Many other comparisons of soils, slopes, and erosion conditions could be made from the tabulated conservation survey data of these areas. The examples given here are enough to illustrate the principle of using

(*Continued on page* 179)

The Conservation of Water

C. R. ORTON

WATER IS THE CONCERN of people and government. It will always be one of the most important of all the renewable natural resources. Dr. Orton's paper considers these factors and points out how the roots of grasses and trees help to properly distribute the rains that fall.

Dr. C. R. Orton is Dean of the College of Agriculture, West Virginia University with headquarters at Morgantown.

MAN IS CONCEDED to be the most important of our natural resources, but of those resources upon which he depends for survival and for development of the artificial or man-made resources, water is the most important.

One may ask why water is more important than sunlight, or air, or the mineral elements. Without any one of these, most forms of life as we know them could not exist on the earth. A practical answer is that sunlight and the air are essential resources but of such a nature that man has very little control over them except for his ability to prevent their pollution locally through smoke and control of poisonous gases. The other two primary natural resources—water and the mineral elements—are largely amenable to control by man through conservation practices. The relative importance of these two is answerable again from the practical viewpoint. Aside from the mineral elements removed by plants, water, through its erosive action, is the agent most effective in removing those elements. If we control the water lost through surface run-off, we conserve the minerals in the soil which are so essential to human and animal health as well as to the health of plants.

Water is Man's No. 1 Problem

From this line of reasoning, supported by the following facts, we come to the logical conclusion that, if man expects to survive on this earth indefinitely and to maintain his status on at least a level basis, he must be convinced that water—whether he has too much or too little of it—is his No. 1 problem. There are six cardinal reasons:

(1) Water enters into the composition of every living cell of every living thing. Without water no form of life on this planet could exist. Plants and animals can live longer without food than they can survive without water.

(2) The present topography of the earth has been determined by water more than by any other factor. Our river valleys, our dissected plateaus, our mountain ravines were all carved by water. Our wind-blown hills, our dust-bowls and our deserts are traceable directly to the failure of man to conserve what water fell on his lands which was necessary to maintain the protective covering of the soil.

(3) The centers of population have invariably been determined by the amount and quality of the available water supplies. No population can exist without ample supplies of water of such quality and quantity as are necessary for potability and for all domestic, recreational and industrial use. When this resource is lost to any community, that community moves away or perishes. Many millions of acres of originally good agricultural land on this earth have been abandoned because the people living on those lands failed to conserve the water which might have maintained their fields and flocks indefinitely.

(4) Water in its various forms and quantities, more than any other factor, determines the climate of the earth, and to a large extent the character and abundance of the vegetation. Those areas where precipitation is low develop the arid or semi-arid climates with sparse vegetation except during a restricted period following the rainy season. Most of the natural vegetation in such areas is drought-resistant. In general, such areas have a restricted population.

In the areas of highest precipitation the vegetation becomes luxuriant, producing the rain; forests and tropical jungles, where conditions are such that human populations are restricted to particular races which can endure the high humidity and the human pests which are characteristic of such regions.

The regions of perpetual snow and ice (frozen water) are very sparsely inhabited because of the severe climate which inhibits plant growth and restricts the diet of humans to water-inhabiting animals chiefly.

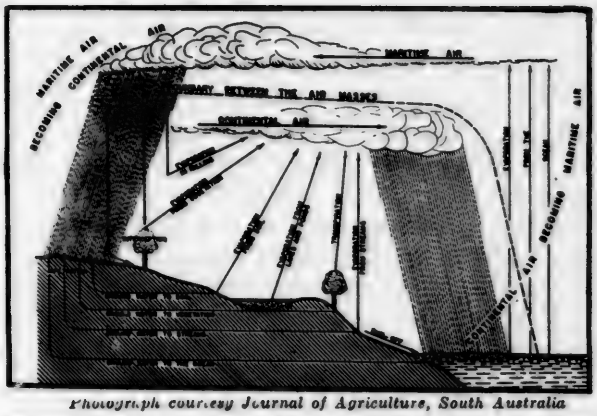
The most satisfactory climates for human habitation and for the production of food and feed are the temperate regions of the earth. Here the precipitation is moderate but generally sufficient for all of man's needs if adequately conserved.

(5) No other medium is more important in maintaining public health than water. The public-health services of the nation and states have placed more emphasis on drinking water than on any other factor. It is the first bulwark in any program of public health. Any commu-

nity which disregards the safeness of its water supplies is rated low by its public-health service. Water pollution, both biological and chemical, is one of our really serious problems.

(6) Water is the most important natural compound in all chemical and biological processes. It enters into practically all chemical reactions. Plants could not utilize the mineral elements necessary for their growth and for human and animal nutrition without water—the sovereign solvent which makes inorganic elements available for synthesis by plant and animal life.

All of our plant and animal products have a high percentage of water. Even that most important food—milk—is composed 87 percent of water and it must be of good quality for best milk production.



Photograph courtesy Journal of Agriculture, South Australia

Figure 1. The circulation of water in relation to sea, air and land.

The Real Source of Water

Many other reasons could be given regarding the importance of water, but recognition of those cited should be sufficient to convince everyone of its primary importance. The chief obstacle to its recognition is the same as that of any other matter of importance, namely, the slow process of education. Only by constant repetition and demonstration is any fact impressed permanently in the public mind. "You never miss the water 'till the well runs dry."

If water is so important, then it must be conserved. In order to conserve water we must understand the fundamentals of the water cycle. Naturally we think of the land as the source of the water we use daily. It comes from springs, wells, and streams, all of which drain out of the earth. But where does this water which is so readily available to most of us come from originally? It isn't manufactured in the earth.

The real source is the great lakes and the oceans (Figure 1), which cover approximately three fourths of the surface area of the earth. Evaporation is constantly taking place from these great reservoirs. Condensation occurs in the atmosphere to form clouds which drift over the land surface where they encounter changes in temperature which cause the condensed moisture to precipitate in the form of rain or snow. It is at this point that man's problem really starts. Unless he can hold and absorb this precipitation where it falls, it escapes through surface run-off, causing erosion, floods, drought, and human suffering. If we hold and absorb the raindrop where it falls our springs will continue to run, our wells will remain well filled, our streams will flow, and vegetation will persist indefinitely.

Under such conditions of water conservation the loss of water from the oceans by evaporation will be restored through the return of water from the streams and by precipitation returned from moisture evaporated from the surface of vegetation, from the soil, from ponds and streams, and from transpiration—all of which may be returned to the ocean and so complete the water cycle. So far as we know, the earth's supply of water is constant.

As already stated, water is the great factor in determining climate. The amount of precipitation varies greatly in different parts of the earth and even in different parts of small areas. Even in a mountainous state like West Virginia it varies from 30 to 60 inches annually in different areas. Much greater variation occurs in other restricted parts of the earth. Some desert areas have practically no rainfall. Some tropical areas may have several hundred inches annually. We may conclude that any agricultural areas should have at least 20 inches to be self-sufficient, and all of this must be conserved. When precipitation falls much below this point, irrigation becomes a necessity for maintaining a permanent agriculture.

Of special importance in agriculture is the seasonal distribution of precipitation. There is little that man can do to regulate it—that is, to spread it out over the growing seasons so that the various crops will always have sufficient rainfall for growth and maximum production. Rarely is precipitation distributed evenly throughout the seasons. It is this fact that makes the problem so important. It often happens in this region that we get our greatest rainfall during a short spring period or late fall season with light precipitation during the rest of the year. This results in water falling more rapidly in one season than our present system of land-use can absorb it; at other times there occur long periods of deficient rainfall, causing drought. Frequently these droughts come at critical crop periods and serious production losses result.

Hold Water Where it Falls

Since these irregularities are the rule, resulting in too much or too little available water at critical periods, the problem becomes one of holding the water when and where it falls and releasing it gradually to supply our needs over the intervening period of low precipitation. This may be accomplished in part by artificial methods—large reservoirs and flood-control dams—or it may be accomplished by the natural method of returning the earth's surface to a land-use comparable to that which mother nature provided before we despoiled it. Dams have their place but watershed protection by means of establishing the proper kind of cover is by far the more important. The problem of water conservation becomes then the watershed problem of protecting every inch of soil with the type of vegetation to which it is best adapted from the standpoint of holding and absorbing all the precipitation falling on it.

To accomplish this we must understand how to hold and absorb the precipitation where it falls. The principle may be illustrated by any waterproof surface—a floor or a table. Water sprinkled on such a level surface remains there until it evaporates. When, however, a blotter or a rug is placed on the same surface and sprinked with water, the water is promptly absorbed. Or if thousands of holes were bored through the table top or floor the water would disappear in them—some of it would be absorbed by the pores in the wood but some would run through and fall on the next obstacle below.

We can liken the table or floor to the surface of the land. If this surface is compacted and devoid of vegetation it is unable to absorb water rapidly enough to prevent excessive run-off and evaporation. If, on the contrary, there is a good vegetative cover and if the soil contains sufficient humus and organic matter, the water is quickly absorbed, and little if any run-off occurs. We have in this case both holes and a blotter. Holes made by the plant roots, earthworms, insects and emerging rocks and stones, and the blotter made up of the humus and organic matter in the topsoil. Such a surface of a few inches thickness is capable of absorbing up to an inch of water quite rapidly. It takes up the water until saturation occurs. If more water falls than can be quickly absorbed by the topsoil, the remainder accumulates if on level land or runs off on sloping land. This means that much of our rainfall escapes, for comparatively few of our topsoils are supplied with enough humus and organic matter to take up as much as an inch of rainfall at one time unless it falls slowly over several hours. Many of our rains are of the intense type, falling much faster than the ordinary soil can take it in. The

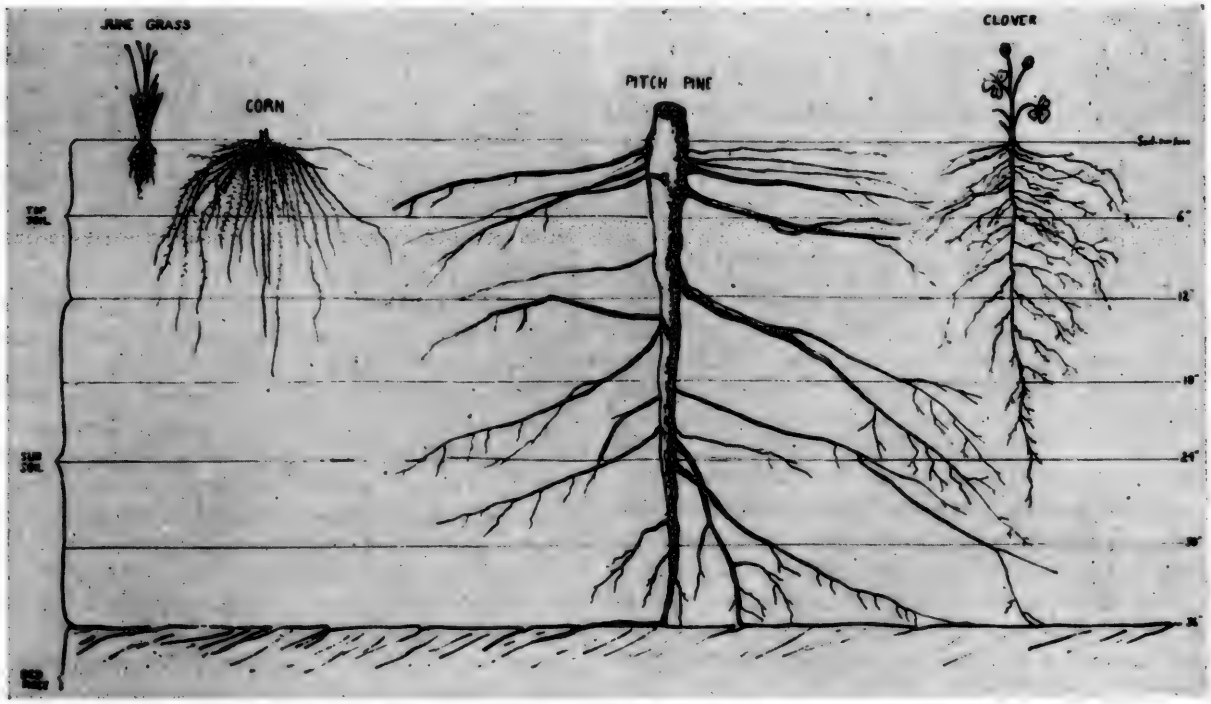


Figure 2. This chart is designed to show approximate relations between the root systems of different plants and their penetration into the variable soil horizons. Very few top soils are as deep as shown on this chart.

result is that in such a hilly and mountainous state as West Virginia, the annual water loss from surface run-off is from 15 to 20 inches or more under variable conditions. On some of the hard shale lands east of the Alleghenies the surface run-off may approach 100 percent where the vegetation is sparse. Flash floods are common throughout this hilly country wherever the vegetation on the steep slopes is inadequate to absorb the rainfall quickly.

What then is the solution to this problem of preventing the surface run-off which, if absorbed and stored in nature's water tables, would keep us supplied throughout the year with all the water we would need for every purpose? The answer is simple. Larger, deeper and more holes in the ground. Many of the holes must reach through the subsoil to the bed rock, shales, or other mineral layers which make up the water tables. There may be several such perched water tables in every hill. One can observe them readily in the huge cuts along our highways after a prolonged rain.

Plant Root Systems Provide Solution

Nature provides the solution, i.e., plants of every description and every sort of root system (Figure 2) which penetrate the subsoils, branching in every direction downward, and many with long tap roots which reach and enter the rock crevices and other layers where the water is stored as underground water. Here in the rocks are formed reservoirs which keep our springs, wells, and streams supplied with water. How do plants perform this feat? Merely by sending their roots through the soil, thus making holes for the water, which falls on the leaves to trickle down the stems and follow the roots as far as they penetrate. The action of growing, living roots keeps the soil loose and furnishes the channels for the rapid percolation of water. With the proper kinds of plants growing in the different soil types and slopes, all but the most unusual downpours can be totally absorbed and stored for gradual seepage to the springs and streams which are the fountain heads of our permanent water supplies.

What does this mean in practical land-use? It means a selective system of vegetation largely depending upon completeness of cover and character of root systems. It means grass and legume mixtures for our crop land. If on a slope it means contour farming. If in cultivation it means strip cropping. Slope land in pasture must have perfect coverage of grasses with plenty of legumes. The legumes being deeper rooted will take in the water faster than the grasses, which are shallow-rooted.

Slopes too steep for perfect pasture cover should be in woody plants and trees. The steepest slopes should never be cleared. They should always be producing timber—a product which is now and in the future always will be the most valuable crop to be grown on our steep hills and mountains.

The permanence of our people and of the state and nation depends on water conservation primarily. It will require many years to educate our people to this fundamental fact, even though it is self-evident to any thoughtful person. It is especially important in our mountainous regions like the Alleghenies, which embrace the fountainheads of our streams and rivers. Unless we start at once to revegetate our pastures and reforest our hills and steep slopes, we shall not be able to sustain ourselves indefinitely. Already many acres have been abandoned in these mountains because of the failure of the land owners to conserve their water supplies. Physical rearmament of the land will have to go hand in hand with moral rearmament if we are to continue to have the freedom and the way of life which is the heritage of America.

Land Features Influencing Use

(*Continued from page* 175)

TABLE VI - Erosion Conditions of Cropland on Some Soil Groups

	Proportion of severe erosion[1]	
	On slopes Less than 25%	On slopes More than 25%
	Percent	Percent
Deep well drained acid sandstone and shale	0.7	4.7
Shallow well drained acid sandstone and shale	7.3	50.0
Red clay shale mixed with other materials	27.0	52.4
Imperfectly drained upland soils	1.9	18.2

[1]Over 75% of surface soil lost or numerous deep gullies

present land use as a measure of the significance of various soil characteristics. They also show the interrelationship of soil slope and erosion in a physical land-resource area of over three and a half million acres. For this area topographic position, parent soil material, stoniness, natural drainage, flood hazard, slope, and erosion are shown to be significant soil and land factors.

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1. "Some Soil Factors Which Affect Land Use in the Glaciated Alleghany Plateau of Southern New York." Proceedings of the Soil Science Society of America. 1946. Pp. 448-451.

Recent Research Reviews

—JAMES H. STALLINGS

The Reviews by J. H. Stallings that follow are a regular feature in the JOURNAL. It is hoped that the projects reviewed from time to time will be helpful to conservationists everywhere. Members of the Society are urged to indicate their interest in the kind of research work that should be reviewed.

Soil and Human Health. *By* RUSSELL M. WILDER. *Farmer's Digest, Vol. 11, No. 11, pp. 19-23, April 1948.*

The ravages of soil erosion and the depletion of the fertility of the land which result from over-emphasis on money crops of corn, cotton, tobacco and the like have long been recognized. Washington and Jefferson in their day foresaw the ill effects of it. The accuracy of their predictions is now in tragic evidence, not only on the eastern seaboard but in many other regions. Plantations formerly rich are now depleted and forlorn. The people remaining on parts of this land are among the most badly nourished in our country, making them ready victims not only to pellagra but to disease of every kind. There is good reason to believe that the laziness and shiftlessness of the poor of many rural regions can be laid at the door of malnutrition, that a vicious circle has existed—poor land poor food, indifference, resulting in failure to care for the land and ever poorer land.

Human erosion follows soil erosion and leads to still more neglect of the soil. Classic examples are the formerly rich regions of the ancient world. The programs of food management as recommended in the Conference of the United Nations Food and Agriculture Organization, policies based on nutritional considerations are consistent not only with raising the level of human health but with better, safer farming and more effective conservation of land.

We Can Grow Legumes on Acid Soils. *By* WM. A. ALBRECHT. *Farmer's Digest, Vol. 11, No. 11, pp. 36-42, April 1948.*

The failure of legumes has often been ascribed to the acidity of the soil. Whether this diagnosis of the trouble is correct may be questioned. It deserves reconsideration in the light of our better understanding of the soil and its interactions with the plants. Natural soil acidity is mainly a shortage of fertility in terms of many plant nutrients. Applications of limestone and other compounds carrying the nutrient calcium to acid soils are known widely to be beneficial soil treatments for legumes and other crops.

Only recently have we recognized the fallacious reasoning behind the conclusion that it must be the presence of the acidity in the soil that brings the crop failure when lime lessens the soil acidity and makes better crops at the same time. Soil acidity is not detrimental, but is in reality beneficial. In applying limestone, which is calcium carbonate, there is possibly some reduction in acidity by the carbonate portion. At the same time, there is being applied also some calcium—a nutrient highly deficient in the leached soils—to nourish the calcium-starved crops. This nutritional service comes about both directly and indirectly. It is this better nourishment of the crop rather than any change in the degree of acidity of the soil that gives the bigger and better crops.

The Mechanics of Small Earth Dams. *By* RALPH B. PECK. *Agr. Eng., Vol. 29, No. 5, pp. 210-211 and 214, May 1948.*

During the past 20 years, there has been a rapid development in the application of soil mechanics to large earth dams. These developments have taken place along three principal lines, namely (1) an improved ability to cope with foundation problems, (2) improved methods for classifying embankment materials and determining their suitability for the construction of dams, and (3) improved methods for control of the placement of earth embankments.

On many projects, large sums of money have been justifiably spent in the investigation of subsoil conditions and the determination of the physical properties of embankment materials. These expenditures have resulted in increased safety of earth dams and at the same time in the more economical use of available materials. However, the thorough and costly studies appropriate for large dams can hardly be afforded in connection with small ones less than 40 or 50 feet high. In spite of this fact, certain principles are applicable to structures of any size, and it is the purpose of this discussion to consider a few aspects of small dam construction wherein soil mechanics is useful.

Behavior of Summer Fallow Under Varying Seasonal and Climatic Conditions. *By* H. H. FINNELL. *Paper presented at Okla. A & M College Soil and Crops Conference. Feb. 10, 1947.*

The author attempts to set forth such correlations as exist between the behavior of the summer fallowing in the cropping system and certain seasonal and climatic factors as may serve more accurately to project experi-

mental information. It is concluded that where good crop residue management is combined with fallow practice it can be safely and profitably practiced within its climatic limitations. The only exception which may be noted is the arid marginal zone, where crop failure with or without summer fallow is sometimes so persistent that crop residues disappear in spite of the farmer's efforts to the contrary.

Nutritional Qualities of Range Forage Plants in Relation to Grazing with Beef Cattle on the Southern Plains Experimenal Range. *By* D. A. SAVAGE *and* V. G. HELLER. *USDA. Tech Bul. No. 943. December 1947.*

This bulletin presents results of analytical work as interpreted in relation to plant palatability and use by beef cattle, of blood analyses of the cattle and of special grazing and supplementary feeding tests having a bearing on the food value of the pasture plants.

The Effect of Spillway Storage on the Design of Upstream Reservoirs. *By* M. M. CULP. *Paper presented at Meeting of the American Soc. of Agricultural Engineers in Chicago, December 12, 1947.*

For a proper design the available spillway storage will be equal to the required spillway storage for the assumed design storm as represented by the inflow hydrograph.

The available spillway storage can be expressed with sufficient accuracy as a function of the surface area of the reservoir at crest elevation of the principal spillway, the average side slope of the reservoir just above crest elevation, and the depth of water or stage above the crest of the principal spillway. This functional relationship is based on the assumption that the actual reservoir may be replaced by the frustrum of a cone.

Discussion of Paper Entitled "Reservoir Problems." *By* THOMAS MADDOCK, JR. *Paper Presented at Sedimentation Conference, Denver, Colorado, May 6-8, 1947.*

The author presents the results of a survey conducted on 5 reservoirs to determine the effect of crop acreage changes in the watershed area during the war period on the rate of siltation. These reservoirs were surveyed both before and after World War II. Increased rates of sedimentation were found in the case of three of the reservoirs. This increase appeared to be associated with an increase in the production of row crops in the watershed area.

Effect of Past Management and Erosion on Fertilizer Efficiency. *By* JOHN LAMB, JR., EVERRETT A. CARLETON, *and* GEORGE R. FREE. *Paper presented at meeting Soil Sci. Soc. of Amer. Nov. 17-20, 1947.*

Erosion is a symptom of the kind of soil management that leads to trouble even on level land. If the land is sloping and exposed to raindrops, sheet erosion starts. This is a selective process that on many soils removes the finer surface particles that are relatively high in organic matter and nutrients. Plots were available in New York that were used to study erosion on four soil types for periods up to 11 years. This report is based on one phase of this general study—the extent of the erosion damage as reflected in yield under uniform cropping. Erosion, fertilizer, and different cropping systems during that period changed the soil in a way that has affected plant growth from germination to maturity. Yields of corn fertilized with 1,000 pounds of 10-10-10 varied from 17 to 100 bushels per acre.

Infiltration and its Relation to Soil and Water Conservation Under Irrigation. *By* STEPHEN J. MECH. *Paper presented at the Meeting of the Northwest Sci. Assoc. Spokane, Wash. December 30, 1947.*

Though the application rate cannot be reduced to less than the infiltration rate of a furrow, considerable saving of soil and water can be accomplished by positive means of controlling the irrigation head. Measurements on various farms have shown that in many cases as much as 70 percent of the applied water is wasted from the field. This tail water contributes nothing toward more effective irrigation. It merely moves more soil out of the furrow.

Erosion takes place early in the irrigation. On slopes of approximately 7 percent practically all of the erosion takes place within 3-4 hours after runoff begins.

The use of a large head at the beginning of an irrigation to get the water through and then make a final setting may have some justification for the sake of convenience. From the erosion standpoint the surge of the large stream will cause excessive erosion.

Steep slopes are more vulnerable to erosion than the flatter ones. Under average irrigating conditions where the runoff from the end of the furrow is from 20 to 50 percent, reducing the furrow grade causes a distinct reduction in erosion. It also permits better distribution of moisture and increases the infiltration.

Cultivation and other means of stirring the soil are by for the greatest single causes of erosion.

The possible use of chemicals and flame for weed control has much potential value in erosion control. Vegetation in the furrow itself will hold the soil and reduce soil movement. For most effective control the irrigating furrow should remain undisturbed for as long a time as possible. It is in the furrow, where the soil and flowing water are in contact with each other that the protection is necessary.

A Device for the Rapid Determination of the Erodibility of Soils. *By* V. B. GUSSAK. *Pedology, pp. 481-491. 1946.*

A flume is described in which the erodibility of soils is measured by the volume of water required to wash away 100 c.c. of soil by a surface stream of varying velocity.

A linear relationship exists between the erodibility of the soil and the rate of flow. For some soils the relationship is direct, for others it is inverse. An empirical equation is deduced for each soil:—$E = aq + b$, where E is the erodibility, q the rate of flow of water and a and b are positive or negative constants, depending on the soil. The angle coefficient a is called the "erosion buffer capacity," and measures the sensitivity of the soil to a change in the rate of flow. This coefficient is probably the best single expression of a soil's resistance to erosion. The erodibility as measured by the flume varies with the rate of runoff flow, and one soil may be more erodible than another at one rate of flow, and less at another. Thus, at a flow rate of 5 c.c./sec. a chernozem was 10 times as stable as a drift loam ,but at 11 c.c/sec. the drift soil was the more stable.

The practical significance of these results is that (1) every soil becomes erodible at a certain velocity of surface runoff. (2) any erosion-control measures will be effective only over a definite range of runoff velocities, and (3) these measures themselves alter the erodibility of the soil by altering the runoff regime. Moreover under natural conditions the erodibility of a soil is nil, since the relief of the soil surface is perfectly adapted to the runoff regime. Erodibility varies as a result of an increase in the amount and velocity of runoff whereby the correspondence between the soil and these hydrographic elements is destroyed.

Experiments in the Control of Erosion in Central New York. *By* G. R. FREE, E. A. CARLETON, JOHN LAMB, *et al. Cornell Agricultural Experiment Station Bulletin 831. 1946.*

The purpose of these experiments at the Marcellus and Geneva Stations was to study the extent of past erosion, to determine the types of rain that cause erosion and the season of the year in which erosion producing rains fall. The land under experiment has been farmed for a century and a half. The most pronounced washing is caused by heavy summer thunder showers. Among the measures recommended to prevent erosion are winter cover crops, manure, chopped hay and leaves, as a surface application improved yields on a badly eroded soil on a 5 percent slope. Thawing in the spring may cause serious erosion through runoff because the soil underneath is frozen. Erosion is also affected by the length of slope, long slopes washing more than short ones. A 200 foot slope lost more than twice as much soil as a 36 foot one. Most of the tillage movement of soil is downhill; the important exception is turning the furrow uphill. The difference between movement uphill and downhill was measured by a spring tooth harrow. Each tooth of a spring tooth harrow traveling up a 19 percent slope carried along 4.9 pounds of soil, whereas each tooth carried along 12.2 pounds when traveling down the same slope. The same net movement of soil downhill occurred whether harrowing was done on the contour or up and downhill. Turning the furrow uphill during contour ploughing is a feasible way of moving soil uphill and uses surprisingly little extra power. It is advisable to turn the furrow uphill whenever possible.

Investigations in Erosion Control and Reclamation of Eroded Sandy Clay Lands of Texas, Arkansas, and Louisiana at the Conservation Experiment Station, Tyler, Texas., 1931-1940. *By* J. B. POPE, J. C. ARCHER, P. R. JOHNSON, *et al. USDA Tech. Bulletin 916. 1946.*

The main factors determining the rate and amount of runoff and erosion are soil type, length and degree of slope, state of cultivation and vegetation. Length and degree of slope affect the amount of soil lost but not the amount of runoff. Increasing the slope gradient from 8.75 to 16.5 percent increased the soil loss 2.5 times.

The main practicable erosion-control measures are the retirement of steep land from cultivation and the terracing of gently sloping land. The chief crops of the region are cotton, corn and vegetables. Lack of power and farm machinery is a serious impediment to terracing in many parts of the region. Terraces should be utilized as a base for the adoption of additional conservation measures such as green manuring, strip cropping and rotations. Terrace maintenance is essential. Subsoils erode more rapidly than surface soils, and in general the thinner the soil the more intense will be the control measures required.

Soil losses from terraces having grades steeper than 3 inches per 100 feet were excessive, and inter-terrace erosion became serious when the vertical-interval spacing of terraces exceeded 4 feet.

Bermuda grass and native forest reduced soil loss and runoff to negligible quantities under a wide range of slopes, soils, and rainfall characteristics. A rotation of cotton, sorghum and cowpeas reduced soil and water losses and increased cotton yields as compared with continuous cotton. Applications of organic manures reduced soil losses, but the beneficial effects lasted for one year only.

The Reclamation of the Strip-Minded Coal Lands of West Virginia with Forage Species. *By* E. H. TURNER *and* R. M. SMITH. *Proc. Soil Sci. Soc. Amer., Vol. 10, pp. 429-436. 1945.*

The regrading of spoil banks has resulted in bench terraces with gentle slopes which are topographically ideal for the operation of farm machinery and production of cultivated crops. Under conditions in West Virginia corn or small grain could not be grown successfully on terraced upland spoil areas until humus supplies had accumulated, fresh spoil having a very low

(*Continued on page* 192)

FIELD NOTES AND COMMENTS

Journal Recognition in England

This is one of several items that have recently been called to our attention regarding the JOURNAL and the Society it represents. The item appeared in The Guild Gardner—an English publication.—EDITOR.

"The Dust-bowl is not to have things all its own way. We have received some numbers of a fascinating American JOURNAL OF SOIL AND WATER CONSERVATION, sent to us by The Biotechnic Press, B.C.M./Biotechnic, London, W.C.1. The Soil Conservation Society of America appears to be a voluntary society with strong influential backing, spread over many States.

The point which strikes one most is the very hopeful experiments being carried out in refertilizing dust bowls. We, organic husbandmen, must not be startled at the need for a very heavy dose of non-organic fertilizers with the first year's seeding. Remember there is no bacterial and worm life in this dead dust. The experimenters are earnestly set on restoring humus and once more bringing this murdered soil to life, and without one strong dose of fertilizers they have failed to make a start.

Many kindred subjects such as erosion, are dealt with by experts who write quite simply and clearly, while the photographs add greatly to the readers' enjoyment."

An Unanswered Question Relating to Soil and Health

As a scientist working with soils and as a consumer and parent concerned with the nutritive qualities of food, I found the paper "Soil Deficiencies and Nutritional Troubles in Animals" (April 1948) by K. C. Beeson very interesting. The author has done an excellent job of emphasizing the complexities of the problem of studying relationships that may exist between soil and health —particularly the health of humans.

Whether the author intended it or not, there is to me at least something of a challenge in his paper. He stated that "Quick results (in the solution of the problem) are not to be expected. It took many decades to develop the present knowledge as to how to control cultural factors in the interest of maximum yields and desirable market qualities."

In looking for fire, it is usually considered that one of the first places to look is where there is what appears to be smoke. True the smoke may turn out to be merely fog or dust, but it is very comforting to have it correctly labeled. In 1943, the following sentence appeared in scientific literature[1]: "The nitrate content of such vegetables as beets, broccoli, cabbage, cauliflower, lettuce, etc., suggests that these foods may be toxic at times to humans." The author goes on to say that ". . . it *appears unlikely* that the nitrate from this source alone will be *very often indirectly dangerously poisonous* to them." The *italic* is not in the original reference.

Should not further study of this "smoke" be given a rather high priority by those interested in relationships that may exist between soil and health? It does not require too much imagination to relate this condition to factors utilized to produce the "maximum yields and desirable market qualities" which Mr. Beeson mentions. Furthermore it does not require too much imagination to relate this also to soil deterioration, soil organic matter, and erosion. These ideas would appear worth consideration as a working hypothesis worthy of further study.

Perhaps we need not be particularly concerned as to whether humans are likely to get enough nitrogen in inorganic nitrate form in vegetables as to be "dangerously poisonous." This same scientist in another paper[2] refers to the use of saltpeter (a nitrate) as an anaphrodisiac.

Additional data on the problem which Dr. Wilson has presented will not solve all the ailments of soil, animals, and humans, but such data do stand in the literature as something which should be refuted or supported by further research.

—GEORGE R. FREE, *Ithaca, New York.*

"On Hillside Ditches"

A. W. Veneable of Brownsville, Virginia, writing "On Hillside Ditches" in the Farmers Register in 1838 saw the need for erosion control. Here is what he said. ". . . My own experience has fully confirmed me in the conclusion that the water should be discharged on a permanent grass plot, which should always be sown in every ravine when land is first cleared and in old lands, on the first effort to improve them. When the field is in cultivation they may be mowed for hay: when in pasture they are much the more productive parts of the whole. The imperfection of the hillside furrow or ditch whether opened with the plough and hoe or with the spade is that heavy rains cause them to overflow and break and fill them up with sand and mud: and where they break a gully is made at once. The cleaning out is a serious labor and if negelected they become utterly worthless.

[1] J. K. Wilson. Nitrate in plants: Its relation to fertilizer injury, changes during silage making and indirect toxicity to animals. Jour. Amer. Soc. Agron. 35:279-290. 1943.

[2] J. K. Wilson. Nitrous acid and the loss of nitrogen. Memoir Bul. 253 of the Cornell University Agricultural Experiment Station, Ithaca, N. Y. 1943.

They are often constructed with too little fall and almost uniformly too long. . . .

My attention was first called to what I esteem the best mode of draining and preserving hillsides by the practice of Richard N. Veneable Esq. of Prince Edward, who has combined the most efficient means of preserving lands from washing and reclaiming that already washed and gullied.

Instead of a graduated ditch or furrow with a bank thrown up by the plough or spade which presents an uncultivated ridge all along the bank of the ditch grown up with briers, bushes and weeds, a bed should be thrown up by the plough ten or eleven feet wide, graduated with sufficient fall to discharge the water, with a deep water furrow on the upper side of the bed leading to the first ravine, where there is a grass plot to receive the water and conduct it off. This bed is ploughed up with the rest of the field and cultivated with it, always taking care that the bed is left in the same place and the furrow opened with the plough. These beds are made sufficiently numerous to drain all the water which falls on the land; and the intermediate spaces cultivated level, or as may be preferred, or according to the nature of the crop. This bank or bed being wide and strong and withal of a capacity to be measured by estimating the space from the highest part of the bed to a corresponding level above it, will rarely if ever overflow, and if it should, it will only discharge the surplus water and not cut away the whole wide bed as it always does the bank or ditch or furrow when the accumulation of water causes a breach in the bank. Under this system the whole field is cultivated. . . .

I repeat the advice to sow a narrow belt of 12 to 15 feet in each considerable ravine, which must be permitted to remain untouched. When the field is ploughed for cultivation it is a complete protection against any wash there; a fine spot of meadow or pasture: and the additional moisture it receives by being used as a receiver and conductor of hillside water from the draining beds, secures a certain and heavy crop for grazing or hay.

In order to complete success, the beds should be as short as convenient and the fall considerable, just so as to prevent washing in the discharge furrow. It is always best when there is a considerable distance between two ravines to begin in the middle of the hillside and discharge the furrows each way; thus securing a rapid passage to the water, and effectually preventing such accumulation as would overflow the beds. Land thus laid off should be always cultivated with reference to this organization and the bed will retain its height and position."

—PAUL TABOR, *Spartanburg, South Carolina.*

Forest Land Use in Oregon

Ten years ago the forest and agricultural interests of Oregon met in headon conflict over the use of two million acres of cut-over forest lands in the state. The agricultural people, led by the livestock group, believed that the stump lands should be developed for pasture and range use. Such development usually required the use of fire and widespread burning prior to the sowing of grass seed and consequently the forest agencies, including the state and federal forest services, did not view the program with much enthusiasm. The graziers likewise regarded the growing of trees on potential grass lands rather coldly, especially when stumpage was down to $1 or less per thousand board feet.

The two million acres of depleted forest lands concerned were owned largely by the 36 counties of Oregon and had been acquired through tax foreclosure channels from timber owners not interested in permanent forest crop production. Other far-sighted or more fortunate owners retained their cut-over lands for continuous cropping and later realized substantial profits from such a decision. Such was the commonplace history of the lands in question. It had happened in the Northeastern and Lake States, now it was happening in Oregon.

The problem facing the technical services, the Oregon State Board of Forestry and the Agricultural agencies was clear. A land use problem had arisen and a solution must be obtained which would yield the greatest benefits to the people of the state and yet not impair the renewable timber resources of the state. Should cutover lands be seeded to range grasses and the natural reproduction be prevented from restocking the land, or should the young trees be permitted to replenish the depleted areas?

Such was the question that faced the men of the forest protection agencies who must keep timber growing and the men who must make a living by developing new range lands for a flourishing livestock industry.

Oregon has long been famous for both its fine timber and livestock. It was the opinion of the Oregon State Board of Forestry that properly handled, it could continue to have both.

Fortunately, the livestock interests were represented by fine leaders who immediately sought a scientific solution to the problem. These men were joined by the foresters and legislation was enacted by the Oregon Legislature which provided for the scientific classification of forest and grazing lands.

Under this law, special county land use committees recommended areas adaptable for either forest or grazing use (Figure 1). Following a field examination, these recommendations were officially acted upon by the forest land classification committees, and the lands classified

in a manner commensurate with their most practical land use. (Page 2 of Bulletin No. 12, Oregon State Board of Forestry.)

While the administrative machinery for classification was comparatively simple, the task of determining which lands would be dedicated to range use and which to timber production was not. Ordinarily, the use of fire is curtailed on forested areas since it is not compatible with the establishment of new forests. Under the range development methods, the use of fire in the initial improvement stage was considered a necessary tool.

This obstacle was eliminated by introducing what is known as the fire-break construction plan. This detailed working plan was prepared and administered cooperatively by the forest protection agencies and the members of the local grazing association. Coordination for range development work was generally taken care of by the local county agent. Under this arrangement, the working plan included the establishment of fire-breaks adjacent to public parks, scenic highway strips, or timber producing areas.

Once established, the land classified for range use could be safely developed by using fire as a means of eliminating debris from the tract to be seeded. The fire-breaks also served a useful purpose in preventing escaped logging or lightning fires from destroying forage grasses on developed grazing areas.

The costs of the fire-break construction and maintenance were divided equally, with the forest protection agencies and the county supplying half the costs and the residents of the grazing area responsible for the remainder. The general practice provides for the agricultural people to furnish the labor necessary for hand work and the county and forest protection agencies supplying the heavy mechanized equipment. The policy has proved most satisfactory in Oregon, and more than three hundred thousand acres of otherwise unproductive lands now support thriving livestock. In addition, thousands of acres of depleted forest land have been carefully protected from fires and incorporated into some of the most important tree farms in the state.

In oregon, timber and agriculture go hand in hand. Their payrolls are practically equal and between them return more than $720 million annually to the people of the state. Idle lands produce no tax revenue, nor will they help support our rapidly increasing population. Better utilization of all our resources is a necessity if we are to go forward.

—N. S. ROGERS, *State Forester, Salem, Oregon.*

TO THE EDITOR:

The July issue of the JOURNAL has afforded so much interest that I am impelled to commend you on it. A number of items in it will be useful to me in my conservation class, and with advanced students elsewhere. Two of the articles have been called to the attention of associates, and one of the book reviews has led to our ordering a copy.

—S. S. VISHER, *Bloomington, Indiana.*

Photo by Oregon State Board of Forestry

Figure 1. Typical cut and burned over forest land. If the soil is favorable for grass growth, such areas may be grazed prior to the time reproduction, brush and other growth makes further grazing unprofitable.

BOOK REVIEWS

ROAD TO SURVIVAL. *By* WILLIAM VOGT. *William Sloane Associates, New York. 335 Pages. 1948. $4.00.*

One can imagine that we conservationists are sailing a storm-battered sloop across a windy channel. The sheets are jammed and the luff is in ribbons. We have set the helm while we try to set up a jury rig to keep us under way. In the midst of the patching job some far-sighted sailor takes a look at the horizon to see where our landfall will be.

William Vogt, as busy as any of us on the jury rigging, stops long enough to look forward. His report on this look is his *Road to Survival.*

Vogt did not invent the idea of population pressure. He has, however, spread it out for examination; we find it shocking. Though we are making some progress toward conservative land use, on all sides of us the demand for agricultural products rises at an accelerating rate as a result of geometric increases in population.

Only a few of the most highly developed countries are achieving a more or less steady population. Even in some of these, advances in farming technology have no more than matched the emergence of new pests, new diseases, new problems washed to the front by the tide of improved transportation and increased efficiency in the process of soil mining.

This is the situation in the countries where at least some progress is afoot. But in India, China, Central and South America and many others, the reservoir of soil resource goes down and the population curve shoots skyward.

Vogt surveys country by country the relation of soil and water resources to the agricultural demand, a function of population. Soil erosion, ground water storage depletion, deforestation, surface water pollution, channel sedimentation are pulling downward the curves of available resources, just as Bennett, Jacks and Whyte, and many others have previously reported. But Vogt discusses the mirrored image of this downward trend, the "parabola of misery," the population curve.

The recent emergence of the United States as the most powerful nation lends great significance to these resource-population ratios in the other countries of the world. Lend-lease, E.R.P., and more to come indicate the direction we move: the agricultural resources of the United States are filling the sand bags which we throw into the ever-larger gap between resource and demand, of the less dowered countries of the world. Vogt does not disparage this sand bagging. He uses it as cogent argument for getting on with our own job of conservation.

The initial statement of the erosion problem Vogt presents dramatically by sketches of the homely effects of resource wastage on different individuals of the world. Some readers may find this introduction somewhat labored. I found it much more palatable than the "facts-and-figures" presentation of the world erosion problem. My personal reaction to the propagandizing of the faith may not be representative but I find most surveys of world erosion problems somewhat laborious reading. This is true in some portions of Vogt's book, until he gets on Central and South America. Suddenly the fire of his agile pen lights again. The discussion of conservation problems in Latin America—probably better known by Vogt than by any other conservationist—is completely absorbing.

The concluding chapter of *Road to Survival* is an essay as dramatic and impelling as any statement in the literature of conservation.

The significance of Vogt's book is many pronged. He shows that resource levels and conservation gains must be viewed in terms of population pressures and the resultant changing demands. Moreover, he put the problem in terms of ecological relationships. Only Graham and a few others had stressed the ecologic importance of a balanced soil economy.

His discussion of the population problem is fearless and frank. The rising curves of population in most countries of the world must be stemmed or else we face continually lowered living standards throughout the world.

Population stabilization must be attacked on every front, with leadership provided by the great countries, particularly the United States. For example, lend-lease or other forms of help from this country should require, as a prerequisite, assurance that the beneficiary will initiate programs aimed at population stabilization.

Vogt points out that the social benefits of public health are counter-balanced by the increased drain on soil-derived resources, and, therefore, are accompanied by diminution of the total resource base. Fearful as are famine, disease and other forms of mass slaughter, they have in the past helped to maintain a population in balance with the ability of the world's soils to produce necessary food. Increased food production which has been achieved through science has not met the increased demand incurred by population rises. This increased food production has unquestionably tended toward decreasing the total available land productivity. The decreased productivity and abandonment of worn-out land has merely been masked by opening of new lands and increased production per acre in a few of the richest countries.

The various professions, including medicine and engi-

neering, are urged by Vogt to achieve an awareness of this population problem. As in the case in most conservation problems, each group at present disclaims responsibility for the end result.

There will be many critics of the ideas Vogt delineates. Yet every reader will finish the book with some disturbance of his basic optimism. This shaking of our inherent optimism must be the first step toward action.

Vogt derides the U. S. engineers and the Bureau of Reclamation as "incompetent." He is wrong. These engineers are extremely competent, but the Bureaus for which they work proceed only on single track policies.

Reclamation is guided by the premise that the addition of new arable land is, in all cases, good if it pays. Refurbishing of marginal lands for increased production is good, if it pays. But "if it pays" is a formula which takes no cognizance of many another aspect of a good life. There is no inconsistency to Reclamation engineers, in claiming "benefits to wildlife" to justify construction of a dam, though the reservoir's muddy flats in a dry year mock recreation, wilderness, and wildlife.

"If it pays" will build a dam now for the general benefit of the citizens. Whether the next generation (also citizens) consider that dam to their general benefit is a question not asked.

It is only political roadblocks, not scientific ones, which prevent the Bureau of Reclamation from saying, "We will build a multiple purpose dam *only* if we are assured that soil conservation practices are adopted in the headwaters of the drainage basin."

Present land administering bureaus of government divide responsibilities. That the trees and the soil cannot also divide their respective jobs and operate *en vacuo* does not occur to the government. The present government policies essentially divide flood control from upstream conservation. These policies "reclaim" or put under cultivation new acreage while existing acres go down hill into the reservoirs. We poison predators with one hand while we feed deer and release pheasants with the other.

We deplete the nesting and feeding habits of birds while we claim "wildlife benefits" for the same species to justify the engineering which depleted the habitat.

This Janus-haded approach to land is the keynote of *Road to Survival*. While each of us works at setting up the jury rig to keep the boat afloat, the vessel gradually gets so far off course that our intended landfall can never be gained, and we all drown anyhow.

Vogt suggests that we continue with the jury rig but let's also man the tiller.

—LUNA B. LEOPOLD, *Honolulu, Hawaii.*

SOIL AND WATER CONSERVATION IN THE PUNJAB. *By* DR. R. MACLAGAN GORRIE. *Indian Forest Service, Rawalpinde, West Punjab, Packinstan, India. 290 Pages. 1946.*

The purpose of this book can best be expressed by quoting the Author's summary on the title page:

"This manual attempts to lay down the details of practical field work in the various phases of afforestation of catchments, reclamation of torrent beds and waste land, and the control of runoff from cultivation. In order to show the relationship of erosion control with flood-reduction, a detailed analysis has been made of erosional processes by water and wind as occurring in the Punjab, and the extent to which both are responsible for the destruction of cultivable land and for loss of fertility in land still under cultivation. The steps by which these processes of destruction and desiccation can be reversed are detailed, emphasizing water conservation as an essential step in the fuller use of the land."

The foreword by Sir Evan M. Jenkins, governor of the Punjab, states that the book is a manual intended primarily for officials concerned with Land Management in the Punjab. He adds that this knowledge must pass from the officials to the mass of farmers, many of whom are already interested. Thus he points to a huge educational problem that will have to be solved before conservation can be generally applied.

He points out that heretofore the intensive study of erosion and its attendant evils has been confined to the areas where its effects have been most apparent, but that it is now clear that no boundaries can be set for the work and that it must be extended to the entire Punjab.

While the book is considered as a manual for officials working in soil and water conservation, it might well be put to wider use as a text book or reference work on soil conservation for students who may be preparing for the Civil Service and for the general information of the public, since it is a rather complete discussion of the soil and water conservation problems of the Punjab and their treatment. While the author is a forester, the way he has treated all phases of the conservation problem would not indicate his specialty. Rather one might take him for an agronomist or an engineer.

When reading this book, one is impressed with the similarity of the conservation problems in the Punjab and those of the United States. The discussions of wind erosion, gullying, overgrazing, stream bank erosion, sedimentation and flood control all have a familiar ring and every condition described has its parallel in this country.

At first one gets the impression that perhaps undue emphasis has been placed on structures such as check dams and similar mechanical treatments. In this respect,

many of the illustrations are reminiscent of the ideas of soil conservation treatments in the United States a number of years ago. One wonders if the trend in this respect will change toward vegetative treatment as much in the Punjab as it has in the United States.

Dr. Gorrie outlines a system of land use according to the physical conditions of the land similar to our land capability classification. He states that very little has been done so far to systematically classify the soils and land conditions of the Punjab.

The Punjab Land Preservation Act is quoted which sets up a system of land use regulations and the procedure for applying such regulations to the land. This is somewhat similar to those which the Soil Conservation Districts are authorized to adopt in the United States.

Dr. Gorrie calls attention to the democratic government of the districts in this country by local farmers, but has a slight misconception of the powers of the district governing bodies to enforce land use regulations. Our Distraicts Laws do grant authority to enforce land use regulations but this power is to be used only as a last resort and then only after its approval by a majority of farmers living in the district.

The book is illustrated by numerous sketches and photographs.

—M. W. LOWRY, *Spartanburg, South Carolina.*

Grass in Soil Conservation

(*Continued from page* 158)

enables water to enter more readily for crop production.

Grasses are also important in the conservation of wildlife. They furnish feed for upland game and provide nesting areas for birds, as shown in Figure 4. Without a good grass cover, reproduction of many birds would be greatly reduced.

Summary

Soil conservation problems in the Northern Great Plains relate directly to grassland agriculture. The soil is properly protected and correct land-use assured by: (a) carefully managing and administering existing grasslands, (b) treating rangeland mechanically to reduce runoff and aid in the recovery of a weakened cover, (c) seeding suitable grasses on abandoned cropland and depleted rangeland for increased forage production, and (d) seeding terrace channels and waterways to grasses to allow excess water to drain without gullying. Grass is, therefore, a recognized tool in solving many conservation problems. Without it, the job would be more difficult, more time consuming, and far more costly.

FOR FURTHER READING

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

Of JOURNAL OF SOIL AND WATER CONSERVATION published quarterly at Baltimore, Maryland, for October 1948.

State of Maryland, Baltimore City, SS.

Before me, a Notary in and for the State and county aforesaid, personally appeared John Henry Ferguson 4th, who, having been duly sworn according to law, deposes and says that he is the Publisher of the JOURNAL OF SOIL AND WATER CONSERVATION and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Soil Conservation Society of America, Box 1409, Spartanburg, S. C.
Editor, Walter C. Gumbel, Bethlehem Bldg., Fairmont, W. Va.
Business Manager, Wiley B. Hampton, Box 1409, Spartanburg, S. C.

2. That the owner is: Soil Conservation Society of America, Inc. (No stock issued.)

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CASE

Lessons from Old Paintings

(*Continued from page* 168)

(2) Gray stem dogwood (*Cornus femina*) and rough-leafed dogwood (*Cornus asperifolia*)—These are both excellent border plants. They do best on soils of light to medium texture, are attractive in appearance throughout the year and produce an abundant crop of fruit. The rough-leafed dogwood is more tolerant of drought conditions than is the gray stem.

(3) Bush honeysuckle (*Lonicera tatarica*). Another attractive shrub and an abundant fruit producer. Does best on soils of moderate fertility.

(4) Red - Osier or silky dogwood (*Cornus stolonifera* and *Cornus amomum*). These two forms, while quite different in appearance, are frequently distributed under the same name. The silky dogwood has been used widely in Ohio and has done well even on infertile upland sites. Its best development is reached on more moist and fertile sites.

(C) *Species with value for wildlife but with fairly exacting soil requirements or requiring special planting or maintenance attention.* Not recommended for erosion control plantings. This includes all of the remaining species observed. They are arranged in descending order with respect to their performance on the sites visited.

(1) Perennial pea (*Lathyrus latifolius*). Fair growth on poor sites but too expensive to establish in dense stands.

(2) Mulberry (*Morus alba*). Grows rapidly on sites with moderate fertility but has little erosion control value. Excellent for posts. Fair survival where competition with herbaceous growth is reduced.

(3) Wild plum (*Prunus americana*). The plantings observed are not of this species. They are arboreal in form and have small black unpalatable fruits. No observations are available for true American plum.

(4) Arrowwood (*Viburnum dentatum*). This swanpland species performed remarkably well on dry upland sites in mixtures with dogwoods, plum, and hazelnut. It did not grow well enough to provide good erosion control cover.

(5) Red chokeberry (*Aronia arbutifolia*). Comments on the previous species apply equally well here.

(6) White cedar (*Thuja occidentalis*). One good border planting was observed. Elsewhere survival has only been fair, although growth of individual plants was excellent particularly on highway fills. Of little erosion control value.

(7) Chinese chestnut (*Castanea mollisima*). Survival is poor and growth slow on most plantings of this hoped for replacement for the native chestnut. Some plants have been attacked by chestnut blight.

(8) Red cedar (*Juniperus virginana*). Late spring plantings have proved failures. Natural seeding of red cedar in one planting area has produced plants that are already larger than hardwood planted on the same area at least one season ahead of the cedar invasion.

(9) Chokecherry (*Prunus virginiana*). Fair growth but poor survival. The host of the apple tent caterpillar and the x disease of peaches.

(10) Black haw (*Virburnum prunifolium*). Fair survival but slow for effective control.

(11) Persimmon (*Diospyros virginiana*). Poor survival. Good growth with fruit present in some cases, while in others growth is very slow.

(12) Russian olive (*Elaeagnus augustifolia* and *Elaeagnus umbellata*). Same as persimmon.

(13) Rose (*Rosa setigera*). Poor survival, slow growth.

(14) Japanese barberry (*Berberis thunbergii*). Unable to compete with herbaceous vegetation.

(15) New Jersey Tea (*Ceanothus americanus*). Same as Japanese barberry.

(16) Burning bush (*Evonymus atropurpureus*). Poor survival.

(17) Cotoneaster (*Cotoneaster dielsiana*). Excellent growth only on good sites and where maintained by mowing weeds and grass around it.

(18) *Diervilla diervilla.* Poor growth on the only site where it was tried.

(19) Japanese honeysuckle (*Lonicera japonica*). Poor survival except where planted on good soil. Under such conditions it becomes a pest in the southern part of the state.

(20) Highbush Cranberry (*Viburnum trilobum*). Poor growth and low survival on dry sites where tried.

(21) Winterberry (*Ilex verticillata*). Same as highbush cranberry.

(22) Wild grape (*Vitis spp*). Very poor survival.

(23) Virginia creeper (*Parthenocissus quinquefolia*). Poor survival and slow growth on all sites.

(24) Pin cherry (*Prunus pennsylvanica*). Poor survival.

(25) Bittersweet (*Celastrus scandens*). Poor survival and extremely slow growth.

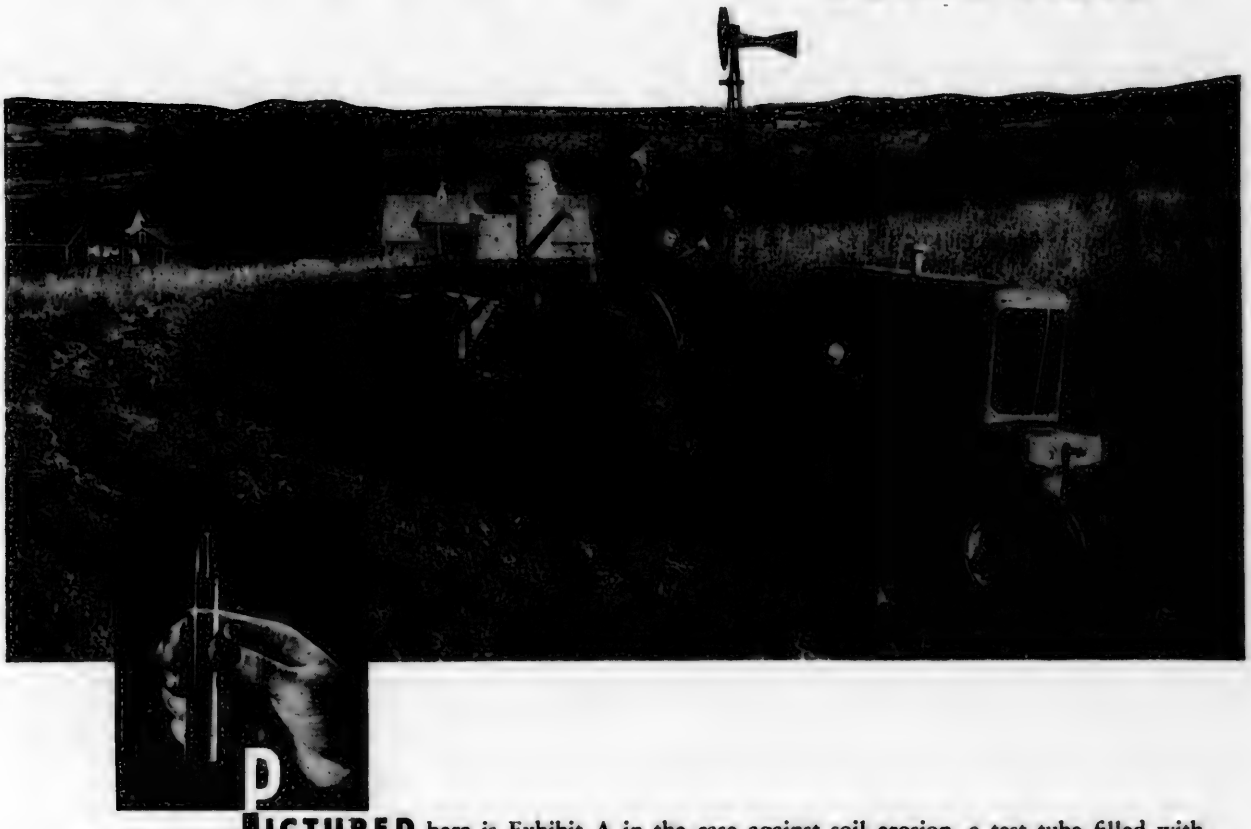
(26) Hackberry (*Celtis occidentalis*). Poor survival, slow growth.

(27) Flowering dogwood (*Cornus florida*). Poor survival, stunted growth (10″ in 10 years).

(28) Caragana (*Caragana arborescens*). Complete failure. Severely attacked by grasshoppers when first planted.

(29) Rose (*Rosa wichuriana*). Failure on highway cut, the only place where it was used.

TERRACES.. *Soil Conservation "battle lines"*



PICTURED here is Exhibit A in the case against soil erosion, a test tube filled with water from the notorious mud-swollen Missouri River. There is unmistakable evidence in the ⅜-inch layer of fertile silt which has settled to the bottom of this glass tube. Here is a revealing sample of the 100,000,000 tons of topsoil swept away every year by this one river alone. When spring and summer rains begin, the Missouri's sediment load jumps from 10,000 to 3,000,000 tons a day — the topsoil equivalent of a 100-acre farm every five minutes.

Allis-Chalmers salutes the Soil Conservation Service on its fight to stop the runaway of our precious topsoil. We are glad to cooperate with Soil Conservation engineers in demonstrating tractor methods of terracing with moldboard and disc plows, strip cropping, constructing ponds, waterways and reservoirs.

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Research Reviews

(*Continued from page* 182)

N-supplying power. The pH of fresh spoil or that subsequently developed on weathering was the primary factor determining ease of revegetation. The physical properties of spoil appear to be of secondary importance. Three types of spoil were tentatively recognized in northern West Virginia. The classification was based on pH. In type A the pH varied from 3.5 to 5.0 with small areas having a pH as low as 2.45. Type B had a most variable pH, but was, in general, favorable to plant growth. Type C had reaction varying from 5.0 to 6.5.

The cost of reclamation on type A would be considerable. Lime, N and P would have to be applied for grass and legumes to be grown successfully. Classes B and C could be reclaimed at a moderate cost. On types C and B applications of N would improve stands of grasses. On type C, P stimulated the growth of legumes. Lime was only necessary for lucerne and sweetclover. The establishment of grass land on spoil terraces appeared feasible provided a proper legume-grass balance was maintained. Suitable legume-grass mixtures are suggested for each type of spoil.

On A and B spoil ploughing was considered to be inadvisable owing to the danger of exposing additional pyritic materials with the consequent development of high acidity. It was found that a very satisfactory seedbed could be prepared and lime and fertilizer incorporated by repeated operations with a weighted springtooth harrow, or a disc harrow on less stony surfaces.

A Headland Designed to Facilitate Irrigation in Erosive Soil. *By* C. H. DAVIS. *Jour. Amer. Soc. Agron., Vol. 38, pp. 859-863. 1946.*

After various methods of irrigation had been tried unsuccessfully a satisfactory method of irrigation was developed by means of a "stilling headland." The soil was moved towards the field, beginning at the ditch bank and continuing to about 20 feet from the outlet so that the ground surface gradually sloped upward from the ditch outlet to the openings of the furrows. The top of the 18-inch outlet was below the water surface and a small basin was dug at the bottom of the outlet. This basin was so designed that the water flowing from the outlet would not wash out a large depression and deposit the sand where it would interfere with water distribution. At the end of the outlet the water rose into a water-filled area which acted like a stilling basin—whence the name "stilling headland." The water velocity was reduced from the outlet velocity to practically nil in the low area next to the ditch. The rate of flow was slow enough to prevent any erosion as the water moved slowly and smoothly to the furrow entrance. The shallowest depth of water and highest velocity were in the furrow and therefore did not interfere with the even distribution of water. The stilling headland must be large enough to permit the turning of cultivating machinery between the furrow and the ditch and narrow enough between borders to permit uniform distribution to the crop rows. It must be deep enough to prevent erosion of the soil and take care of accumulations of soil and debris over several years.

New Developments and Interpretation of Conservation Surveys. *By* L. E. DERR. *Okla. Agr. Exp. Sta. Bul. No. B-259. 1946.*

Since 1942 all phases of conservation-survey techniques and procedures have been re-examined and the Farm Planning Soil Conservation Survey has been formed. It stresses the physical characteristics that affect soil-management practices, crop adaption and mechanical erosion-control measures. Soils are mapped on a 4-inches-to-one-mile aerial photograph according to depth of profile in which plant roots may develop, textural variations, permeability and inhibitory factors such as salinity, stoniness, drainage and cherty or gravely conditions. Slope-class limits have been established and land use or cover is mapped as cultivated, woodland, grassland or farmsteads, urban areas, etc. Mapping of erosion is confined to 5 classes, (1) none to slight, (2) moderate, (3) moderately severe, (4) severe, and (5) very severe.

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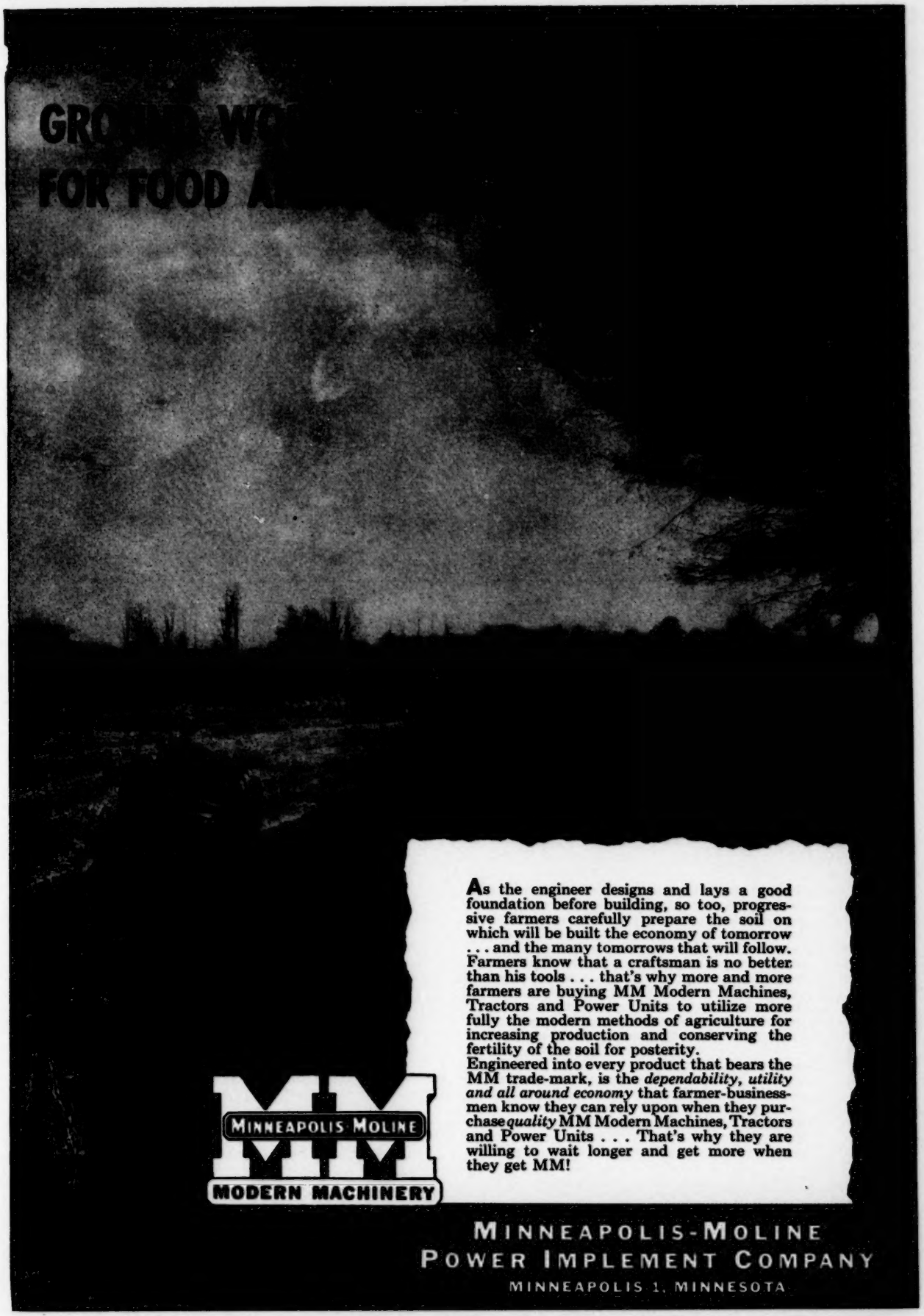

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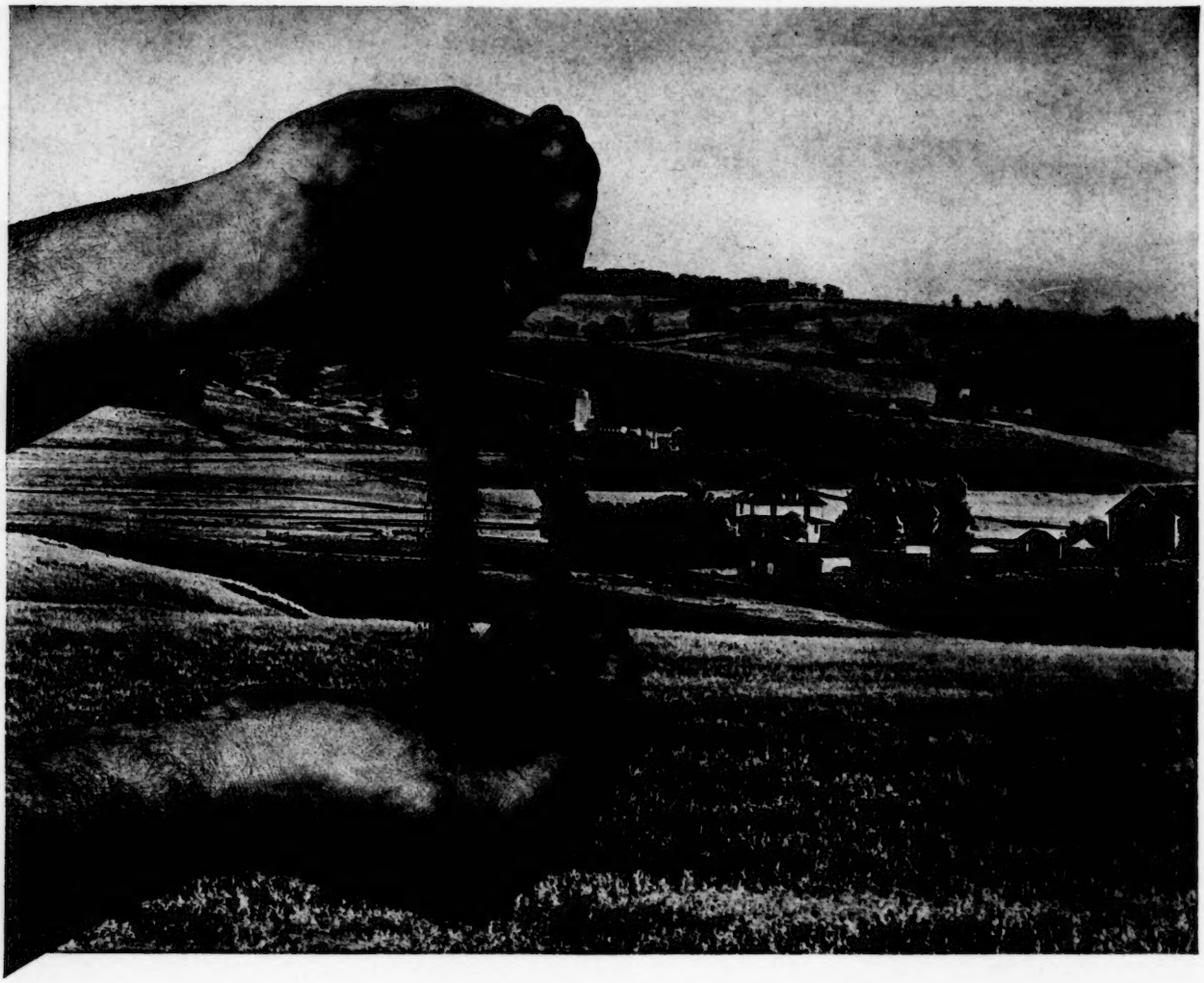

THE SOIL IS OUR STRENGTH

America has grown strong largely because her people have eaten well. Eating well means living well, working well. Those are facts that some of us may overlook. A thriving agricultural-industrial system has put meat and potatoes on our tables, white shirts on our backs, soft rugs on our living room floors.

Such necessities, and niceties, come largely from the soil. A lot of us need to think of that. We need to remember that a biscuit in the hand is just so much protein and starch and fat taken out of the soil; that clothing grows on cotton stalks; that sheep are only walking factories, eating weeds and grasses and grains to grow wool on their bodies; that such a flimsy thing as a paper napkin represents a mite of soil resource taken away from our national stockpile of natural resources.

If we will look upon our day-to-day living in this light, we will understand why a nation of nearly a hundred fifty million persons makes a terrific drain upon soil resources. We will realize why it is necessary for us to maintain the soil, even while using it.

That can be done, but it calls for conservation on *all* of *our agricultural land*, not just a part of it. So far, science tells us, we are draining down our stock of soil resources. We must adopt soil maintenance programs on all of our farmlands. When we have done that important task, we will have removed *soil deterioration* as the greatest single threat to an enduring America.

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